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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION.

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Selling Castings.—I.

The foundry industry, by a process of growth, shows a wide variety of methods by which its products are sold. Large firms who make their own castings and incorporate them into machines have developed their own selling organisations and district offices, through which the consumer can be reached. At the other extreme, the small jobbing foundry frequently has not a selling organisation at all, and is compelled to wait until inquiries come in before any contact with the consumer can be made. Between these two extremes every conceivable method is adopted. The anticipated improvement in conditions suggests that every firm should seriously consider whether it is adopting the best possible method of reaching its consuming public, and, in particular, whether each of the lines manufactured is pulling its weight. It often happens that a business, finding one line exceptionally successful, adds to this line, in the hope of absorbing some of the overhead and selling expenses. If a staff of commercial representatives is employed it is argued that they can quite as easily deal with three lines as with one. Some illustrations from other trades are suggestive. Statistics have been published of a food manufacturer, supplying three different trades, who found that over half his total selling expenses were incurred in supplying one trade, which brought him about one-tenth of his demand. Another discovered that his representatives did 50 per cent. of their business with 6 per cent. of their prospective customers. These cases may be paralleled in the foundry industry among a large number of founders who supply to the wholesaler, or to agents for distribution to the consuming public.

We hope to return to this subject in a later issue, because in our experience no side of the foundry industry stands in such need of development as the selling side. Too many foundries still work on the principle that people are compelled to buy castings and hence are compelled to find out who makes them. This principle does not hold to-day. In the first place there are too many alternative materials and processes which the buyer may be induced to take up by skilful publicity, and secondly there are so many foundries with surplus capacity ready to supply that some proper basis for selling represents an elementary precaution to ensure survival. Hence the space we have been giving in our columns to foundry selling practice.

A Conservative Industry.

Several callers at these offices, commenting upon our Editorial "A Pat on the Back," in which we outlined the phenomenal growth of pulverised-fired melting furnaces within the foundry industry, have used the expression "conservative." We fail to appreciate that the foundry industry is "conservative." The mechanisation of foundries in the Birmingham area, Ipswich, Manchester, Glasgow, Hull, Stanton, Chesterfield, Sheffield, Coventry, Dagenham and elsewhere represents a capital expenditure running into six figures. Moreover, partial mechanisation is to be encountered on every side, whilst those possessing just high-grade well-equipped foundries are only awaiting an increment of business commensurate with a serious capital lay-out. We candidly admit that some concerns are so conservative as to warrant the appelation derelict, and one can readily call to mind a few large foundries having dirty and broken windows; uneven pathless floors, pre-war melting and drying plant, prehistoric sand preparing mills and an odd moulding machine too rusty to work. Some of these have names highly esteemed in the engineering world, but they will have either to modernise their plant or cease to function.

Another direction in which this "conservative" foundry industry has made great progress is in the direction of the production of alloy cast irons. The progress registered is such that the iron foundry is now regarded as a serious factor in the nickel market. The industry now knows more about its raw materials—pig-iron, scrap, coke and sand, than ever before, and is using this knowledge to the benefit of its customers. Its educational, technical and research activities are progressive and are the subject of admiration the world over. Thus, we strongly resent this too frequent sneer of "conservative." It applies neither to the industry nor its personnel. We may not have made such spectacular advances as some other countries, but the progress achieved has been built on the firm foundation of consolidated experience. Generally speaking, it has been slow but sure, and our answer to these accusations of conservatism is that this last five years has witnessed radical changes within the industry.

District Presidents.—No. 3.

BIRMINGHAM, COVENTRY AND WEST MIDLANDS BRANCH OF THE INSTITUTE OF BRITISH FOUNDRYMEN.

Mr. J. G. Pearce, President of the Birmingham, Coventry and West Midlands Branch of the Institute of British Foundrymen, is well known in the industry as the Director of the British Cast Iron Research Association, to which post he was appointed in 1924, and subsequently also as secretary. In the same year the Association began its first laboratory and the development then begun culminated in July last in the opening by Lord Rutherford of Nelson of the Association's newly-extended laboratories in Birmingham. Mr. Pearce has made a number of contributions to the study of cast iron, particularly in connection with mechanical testing, and has given about half a dozen Papers to or on behalf of the Institute of British Foundrymen, including a Paper to the London Congress, 1929, the American exchange Paper at Cleveland in 1930 and a Paper to the Birmingham Conference in 1931. Other Papers have been given to the

Mr. J. G. Pearce

(*Chairman of the Birmingham, Coventry and West Midlands Branch of the Institute of British Foundrymen*).

Iron and Steel Institute, Institute of Mechanical Engineers, Diesel Engine Users' Association, West of Scotland Iron and Steel Institute, etc., the last being given, jointly with Mr. E. Morgan, to the Iron and Steel Institute's last spring meeting on "Ingot Moulds."

Mr. Pearce is keenly interested in education and standardisation in relation to the industry. He is a member of the Council, Literary and Education Committees of the Institute of British Foundrymen and of the Advisory Committee on Education of the City and Guilds of London Institute. He is a member of the Council of the Iron and Steel Industry Division of the British Standards Institution and of various of its committees and sub-committees, and of the Iron and Steel Industrial Research Council. He represented the British point of view with respect to the testing of cast iron in a Paper given at the International Congress, held at Zurich in September last, of the International Association for Testing Materials, which was followed by a discussion in which European specialists took part. He is a member of the Institution of Electrical Engineers, of the Institute of Metals and other scientific and technical societies, and a few years ago was awarded first prize in a national competition for the most effective and practicable methods of promoting industrial good will and efficiency.

Correspondence.

[*We accept no responsibility for the statements made or the opinions expressed by our correspondents.*]

Deoxidation of Metals.

To the Editor of The Foundry Trade Journal.

Sir,—I shall be glad if you would grant me space in your valued journal for a few remarks on the article printed in the current issue headed "Deoxidation of Metals in the Foundry."

In commenting on the assertions made, I contend the writer of the article is conveying a very wrong and misleading impression regarding the mentality of "The Foundryman." He commences by saying the deterioration in the finish and quality of the castings is caused by the neglect in not understanding the operations of deoxidation.

Oxidation is caused principally by incorrect melting conditions, and if close supervision is maintained with the knowledge of your materials, whether virgin or ingot metal to analysis, then the question of a deoxidant does not apply; when using unknown scrap, then the function of a deoxidiser is allowable. Deoxidisers always savour of the quack trying to make bad material into good. I should venture to say that in no foundry of any repute, which is producing high-grade non-ferrous castings, is the practice of stirring the metal with an iron rod tolerated when introducing alloy additions. In conclusion, I should say the suggested method as shown per sketch is not a very practical proposition. The vital factors are "common sense" and practical experience to ensure correct melting and pouring temperature when 75 per cent. of the troubles in unsound castings will be eliminated.—Yours, etc.,

J. Dunn.

Willenhall, Staffs.
August 27, 1932.

[The article in question is of German origin and was translated.]

Vee Belts.—A Correction.

To the Editor of The Foundry Trade Journal.

Sir,—We have subscribed to your paper for a number of years and are always most interested in the helpful information contained therein. On page 116 of the present issue there is a small note to the effect that Vee belts should be dressed with castor oil, and we should be very much obliged if you would correct that statement, which is absolutely wrong.

Endless Vee belts, as constructed to-day, of bias-cut woven fabric with an endless core, must on no account whatever be dressed with *anything at all*, more especially oil, which has a disastrous effect.

We have drives installed amounting to over 100,000 h.p. all over the country, and very many of these are for use with foundry compressor drives, and if this advice were taken it would be most injurious to the ropes and entirely detrimental to the drive.—Yours, etc.,

Smith & Grace,
Screw Boss Pulley Company, Limited.
H. W. Puddefoot,
Managing Director.

Thrapston, Kettering.
August 26, 1932.

[We are extremely obliged for the correction and are taking up the matter with our contributor, whom we have always regarded as reliable. —Editor.]

Random Shots.

A journalist has suggested that our seaside resorts should each endeavour to cater for a definite type of holiday-maker, instead of appealing, as they do now, to all and sundry. There is a good deal to be said in support of this scheme. Sunbathing enthusiasts, for instance, could be segregated somewhere along the south coast. That would relieve the Press photographer of a considerable amount of travelling to and fro between the various resorts. And judging from the picture-pages of the newspapers, it would necessitate a service of special trains, reserved expressly for Press photographers to run daily between London and Sunbathing Paradise. It is not that aspect of the plan, however, that "Marksman" is particularly interested in.

* * *

What really is wanted is a resort which would serve exclusively as a centre in which the conferences, conventions or congresses of our various associations, institutions, societies and institutes could be held. For such a seaside centre "Marksman" foresees a tremendously important future. Conferences of one sort and another are being held practically every day in this country, and they might just as well be held in a town designed and equipped for the purpose.

* * *

What a tremendous amount of useful work the associations themselves could do in the realisation of the conference city. The preliminary details could be entrusted to the National Housing and Town Planning Council. Then the Royal Institute of British Architects could step in and carry things a bit further. The Associated Master Plumbers and Domestic Engineers could be given an opportunity to shine. Or ought "Marksman" to say that of the Illuminating Engineering Society instead? The Institute of British Foundrymen, incidentally, could be entrusted to look after the castings side of the business. And a job of a work might even be found for the Institution of Railway Signal Engineers and the Institution of Engineers in Charge. When the city was finely completed, one important thing would remain to be done. That is the formation of an Association for the Planning of Conferences.

* * *

Some time back "Marksman" suggested that the bowler hat might be made of sheet aluminium. A correspondent later wrote that this was actually being done, the hats being used as the "mutes" for dance-band instruments. The same correspondent now returns to the subject once more with the news that another sort of "hat" is being made of aluminium steel. Messrs. Platt Bros. & Company, Limited, are making for Russia a number of spinning frames for asbestos spinning. The frames each carry 120 "tin hats" (a textile term, this) made up from aluminium sheetings, so that the term "aluminium tin hats" would seem appropriate.

* * *

"Marksman" already has an entry, for the next International Aluminium Competition. Why "tin gods"? Why not "aluminium gods"?

* * *

IN BRIEF.—II.

The News Reel.

Trooping of the colours.
Race (motor, horse and marathon).
Sports meeting.
Trooping of the colours.
Channel swimmer or boxer in training.
Sports meeting.
Trooping of the colours.

Marksman.

Black-Heart Fractures in White-Heart Malleable Cast Iron.*

A STUDY IN ANNEALING.

By J. V. Murray, M.Inst.B.F. (Murray Foundries, Limited, Walsall).

The presence of a true black-heart fracture—*i.e.*, the picture frame of ferrite crystal grains surrounding the soft black velvet centre—has often been both a source of annoyance and irritation to many malleable foundrymen. Often it will appear in a batch of work from an oven accompanied by lighter fractures which are indicative of white-heart malleable. The author has heard it stated that it is due to the chemical composition; that it is due to low-temperature annealing, or to the presence of too much carbon in the graphitic state. Picture-frame fractures have been found in cupola, crucible and air-furnace metal of various chemical compositions. Black fractures have been found in true white-heart annealing temperature, *i.e.*, 980 deg. C. conducted furnaces. Carbon contents ranging from 1.5 to 3.40 (after annealing) sometimes show these black-heart fractures in white-heart malleable, and they appear to persist in spite of all attempts to prevent them.

In a recent work[1] the author found a species of this type of fracture when 2.71 per cent. Ni was present. In this case, however, the picture frame was 50 per cent. of the total area of the casting. The present work is the outcome of this "bull's-eye" fracture, in order to ascertain at what point or points the chief reactions occurred and to suggest any method of their prevention, if possible.

Experimental Data.

A series of test-bars was cast from a cupola during ordinary routine work of a malleable foundry. They were cleaned in the usual commercial manner, and, after inspection, two bars, a tensile and a bend-test-bar were placed in an iron container, which was filled with a mixture of red ferric oxide (Fe_2O_3) and used oxide (Fe_3O_4) in the ratio of one to four. Nine of these containers were prepared in a like manner and luted up with a mixture of ganister and red sand in which was a dash of fireclay. These nine small "annealing cans" were placed on the top layer of cans during an ordinary commercial anneal, *i.e.*, thirty-six hours to attain a temperature of 950 deg. C., six full days at an approximate temperature of 950 deg. C., and two days of cooling after the firing had stopped, and the furnace very slowly cooled.

A container was extracted from the furnace each day by pushing it off the annealing can and extracting it from the fire where it had fallen. It was then placed in the warm ash-hole underneath for four hours and then allowed to cool in the air. Afterwards the bars were taken from the container and cleaned in the usual commercial way by sand-blasting. The first was taken out of the furnace after having 24 hrs.' annealing at 950 deg. C.

This was repeated every 24 hrs. at exactly the same time, so that each succeeding one had an increased time of annealing by this amount. The furnace was controlled by a Féry Optical at one end of the furnace and by a thermo-couple automatically recorded on a Cambridge pyrometer at the other. It was hand-fired by coal. Between the hours of ten at night and seven the next morning a temperature drop of 150 deg. C. was recorded. A copy of the chart is given, Fig. 1.

Mechanical Tests.—The ordinary mechanical tests demanded by B.S.I. were carried out. The results are given in Table I.

Chemical Tests.—Certain chemical tests were carried out where the percentage of elements are likely to be altered by the heat-treatments. These will also be found in Table I.

Microscopical.—Each bar was examined microscopically. Photographs were taken of the edges of the specimens and also at the centres. The results are discussed herein.

Macroscopical.—The fractures of the various bars were examined and noted.

The analysis of the original white bars was:—T.C., 3.48; C.C., 3.48; Si, 0.61; Mn, 0.26; S, 0.153; and P, 0.075.

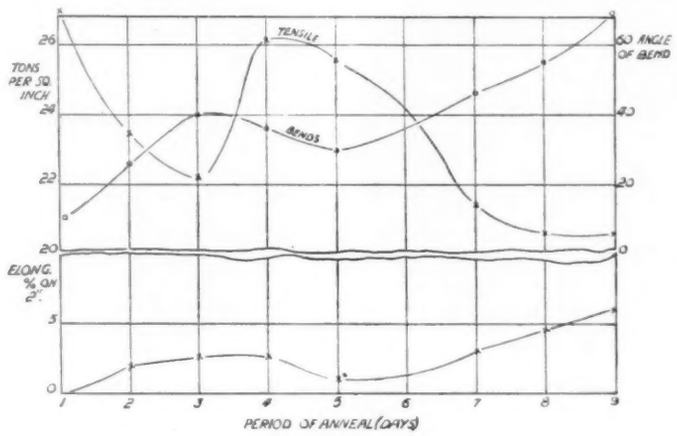

FIG. 1.—TEMPERATURE CHART.

TABLE I.—*Details of Tests.*

No. of bar.	Time of anneal Days.	Total C. Per cent.	S. Per cent.	Tensile strength. Tons per sq. in.	Elongation on 2 in. Per cent.	Angle of bend. Deg.	Brinell No.	Rockwell B scale.	Fractures and remarks.
1	1	3.43	0.174	27.8	Nil	11	168	90	Picture frame, light centre.
2	2	3.43	0.188	23.5	2.0	26	138	86	Picture frame, jet black centre.
3	3	3.22	0.176	22.2	2.5	40	114	75	Picture frame, jet black centre.
4	4	2.11	0.153	26.5	2.5	36	129	75	Bull's eye, jet black centre.
5	5	2.22	0.163	25.6	1.0	30	138	81	Bull's eye, smaller, jet black centre
6	6	1.78	0.175	—	—	—	125	74	Crystalline centre, firing ceases.
7	7	1.40	0.213	21.2	3.0	46	121	75	Crystalline centre, greyish soaking.
8	8	1.45	0.204	20.4	4.5	55	107	70	Lesser crystalline, more fibre cooling.
9	9	1.38	0.225	20.4	5.4	67	110	74	Lesser crystalline, more fibre cooling.

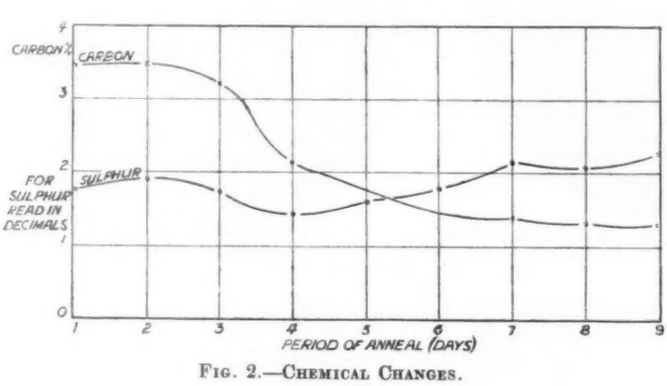

FIG. 2.—CHEMICAL CHANGES.

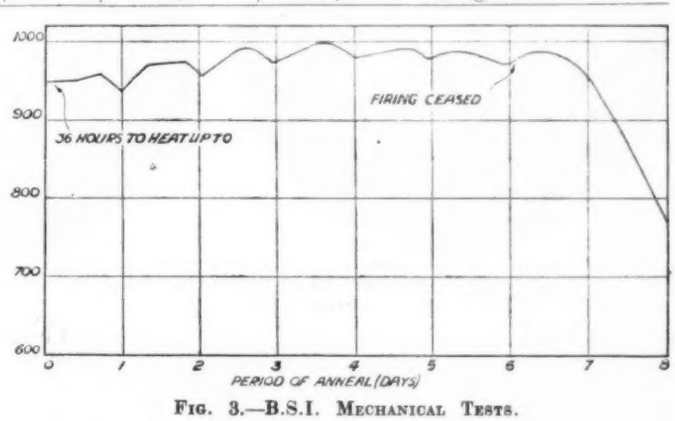

FIG. 3.—B.S.I. MECHANICAL TESTS.

* Paper presented before the Birmingham Branch of the Institute of British Foundrymen, on October 9, 1931, Mr. J. G. Pearce presiding.

1 Murray: "Staffs Iron and Steel Institute." Vol. 45. Page 43.

Results Analysed.

The tensile strength was surprisingly high with only one day's anneal; this being the highest recorded. It afterwards dropped to "normal." On the fourth day the tensile increased, and remained so until the seventh when there was a drop back to "normal." The fourth day showed a slowing up of elongation value followed by a decrease, but on the seventh day increases were again recorded. There was a systematic increase of bend which again eased up in the fourth day. The seventh day it appeared to increase again. The Brinell and Rockwell Nos. are given for what they are worth. Since the B.S.I. does not call for them, no comment is offered.

The fractures or macros are very distinctive and show to some extent the position of the anneal. Bar No. 1 showed the picture frame (black-heart type) but with a light centre. The centre contained a small amount of free cementite. On the bars Nos. 2 and 3 the fracture was a true black-heart to the eye. This covered the period of two days and three days anneal. No. 4 then developed a smaller black centre and the crystalline frame proportionately larger. On the fifth day it was smaller in the black area and developed the "bull's-eye" effect already spoken of. On the sixth day the blackness disappeared and the centre became crystalline and grey like a steel. On the seventh day this disappeared and the macrostructure became grey with a crystalline centre. On the eighth day this crystalline centre became less. The ninth bar was the same.

Fracture Comparisons.

On comparing these fractures with the total-carbon content, it was found that there was very little carbon removed during the first three days. The first two bars give 3.43 per cent. and the next 3.22, a drop of only 0.05 per cent. and 0.26 per cent. C. respectively. The carbon had not commenced to diffuse until the fourth day. Over 1.00 per cent. C. had been carried off on this day. It then travels down normally (about 0.35 per cent.) until about 1.30 per cent. Hence it may be said that the picture-frame effect and the bull's eye indicate the presence of deposited carbon. The first effects of the annealing of malleable cast iron are chiefly deposition, and whilst this chemico-physical effect is taking place little or no carbon is removed. When these cease, then oxidation sets up again and carbon is removed at a greater rate than is normal until a state of equilibrium is reached at that temperature. Then it resumes its normal course.

On the sixth day the firing ceased and the furnace insulated, when it cooled down very gradually and slowly. This explains why Nos. 7, 8 and 9 are practically the same in the amount of carbon present. With fall of temperature chemical action would tend to ease up and cease.

Microscopic Results.

The microscope reveals a quantity of information. At one day's anneal the very edges only have lost their carbon, but a thick emulsive pearlite and deposited carbon band comes next, very sharply demarcated. It is the writer's opinion that the carbon on the edges volatilises, to the point which is defined, and some carbon diffuses into the ferrite. The centre still retains some free cementite, although islands of temper carbon in a small "sea" of ferrite are plentiful. This bar was hard to drill.

The next bar shows that slight diffusion had taken place, but the thick band of emulsive pearlite had decomposed partially, thus relieving many strains due to supersaturation. Islands of ferrite are seen, and the band of pearlite is less intense. The centre, however, is a pure black-heart structure, only ferrite and nodular carbon being present.

Bars of three days' anneal reveal several channels of ferrite with almost normal pearlite, showing that very little carbon has been eliminated up to this time. Changes, however, are taking place in the centre of the bars. From the zone of pearlite, arms are thrown out in columnar formation. This growth of pearlite bars is due to the ferrite taking up the carbon into solution again. Nodular carbon is still present in bulk.

Bars with four days' anneal are very interesting. Here the first "skin" effect is seen. This skin is ferrite and not iron oxide. This synchronises with a great loss of carbon. The arms of pearlite now are thrown right across the samples in bridge formation. Ferrite tends to disappear, although much nodular carbon is still present. Another day's anneal still exhibits the same effects. The skin is roughly 50 per cent. pearlite and 50 per cent. ferrite. The centre now is almost pearlite. Only a few zones of

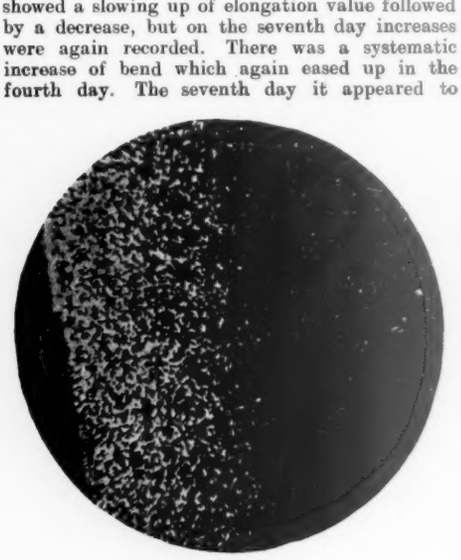

Fig. 4a.—Edge of Sample after 1 Day's Anneal. All Micros are etched in 2 per cent. Picric and Nitric Acid and are × 100.

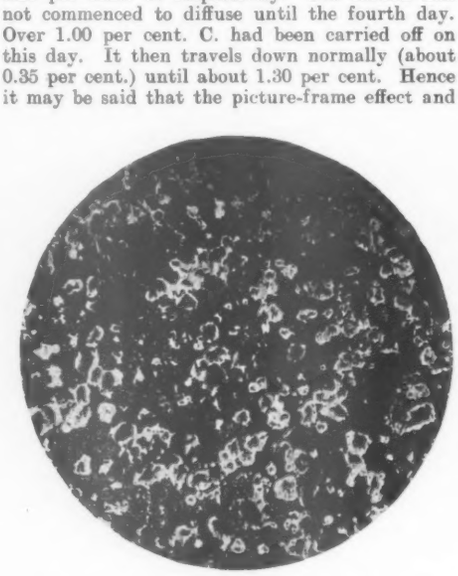

Fig. 4b.—Centre of Sample after 1 Day's Anneal.

Fig. 5a.—Edge of Sample after 2 Days' Anneal.

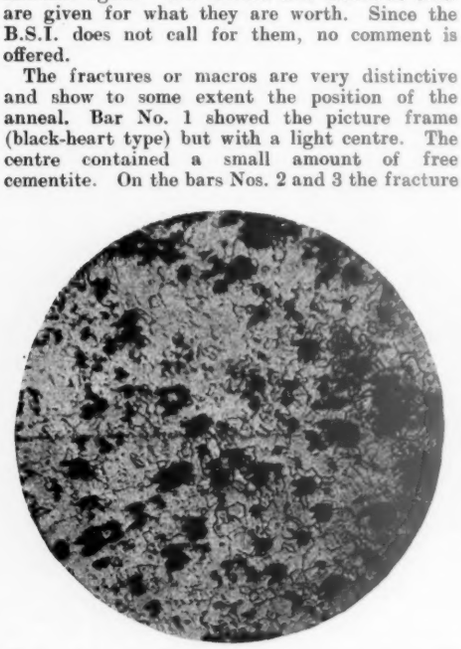

Fig. 5b.—Centre of Sample after 2 Days' Anneal. Pure Black-Heart Centre.

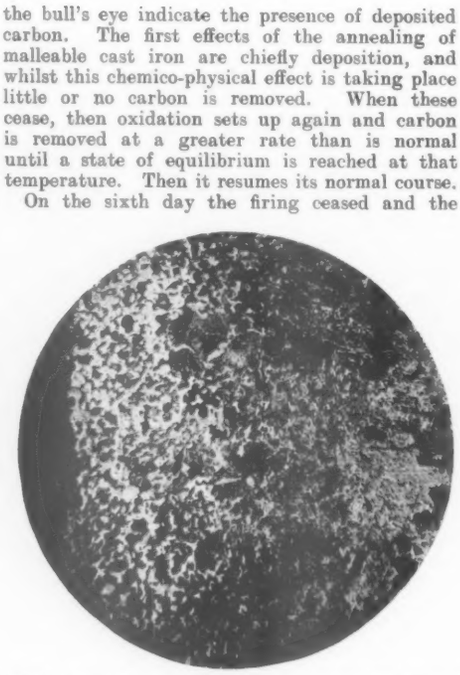

Fig. 6a.—Edge of Sample after 3 Days' Anneal.

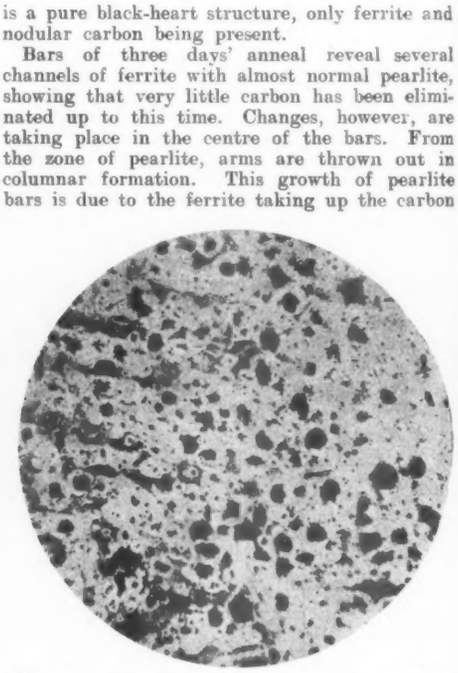

Fig. 6b.—Centre of Sample after 3 Days' Anneal. Note Growth of Pearlite.

ferrite are present. The six days' anneal shows chiefly the annealing effect. The skin is refined, but the centre is composed entirely of pearlite and nodular carbon.

At this period the effect is very slow cooling, although maintenance would be the correct term. The temperature is still above the A arrests. The skin effect is pronounced, but the chief effect is that pearlite commences to get less, and grains of ferrite make their appearance in the centre. This is the seventh day. On the eighth day the temperature, which is still about 700 deg. C., shows that the ferrite zones increase in the centre and the pearlite is less emulsified. The skin area is increasing, some of the pearlite zone having decomposed. The last bars having cooled in the furnace show a well-defined area of ferrite sharply demarcated from the pearlite zone, and a centre of pearlite and ferrite together with a few large nodules of carbon. There is no sign of "peel" or of an oxidised zone.

tinct types. One is a pure black-heart structure showing only ferrite and nodular carbon in the centre. The other, the second, is nodular carbon in a matrix of pearlite, with no trace of ferrite. A series of three tests was made on one sample with a true black-heart centre, with an outer ring of pearlite and ferrite. Table II gives the results.

Such material would pass all the mechanical tests demanded by the B.S.I., yet it is insufficiently annealed for a white-heart malleable. The second one would fail under the tests where life depends upon good material being correctly heat-treated, to give it the maximum mechanical properties it is capable of.

Whilst discussing black fractures in malleable, there is another type of fracture, similar but lacking in lustre and colour. This fracture is of a very dirty colour and may have a picture-frame macrostructure. This particular fracture is caused by greyness in the original casting and is due to (*a*) too much silicon or carbon being present or (*b*) very slow cooling, allowing the carbon to be precipitated.

Fig. 7A.—Edge of Sample after 4 Days' Anneal.

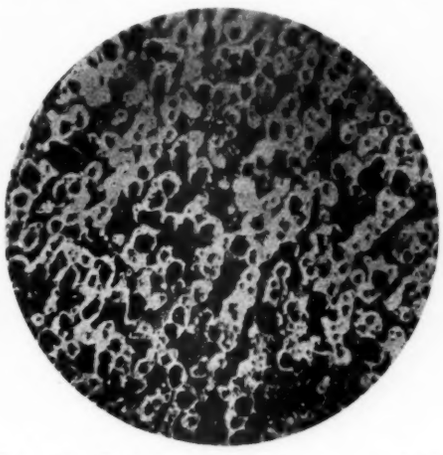

Fig. 7B.—Centre of Sample after 4 Days' Anneal. Pearlite arms increase, forming a series of "Bridges."

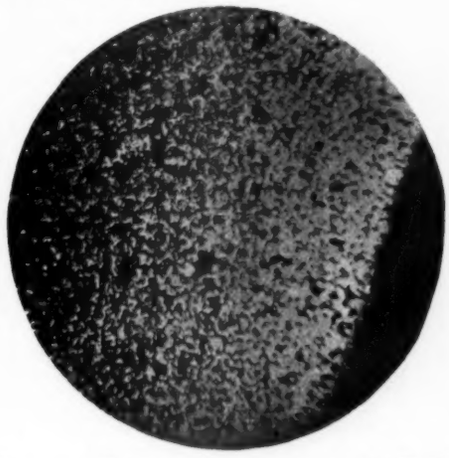

Fig. 8A.—Edge of Sample after 5 Days' Anneal.

Table II.—*Brinell Tests where True Black-heart Centre Exists.*

Zone.	Dia. of impression.			Brinell No. Average.
Centre	0.43	0.43	0.44	196
Pearlite area ..	0.40	0.41	0.42	217
Ferrite	0.425	0.43	0.45	187

The silicon will cause the carbon to be precipitated as flaky graphite, or if too much carbon is present it becomes normally grey. One of the most potent causes of greyness is intermittent tapping out from a cupola where the molten metal lies among lumps of hot coke. At elevated temperature the iron, even if low in silicon will dissolve and absorb carbon from the coke until a state of equilibrium between iron and carbon is reached for that temperature.

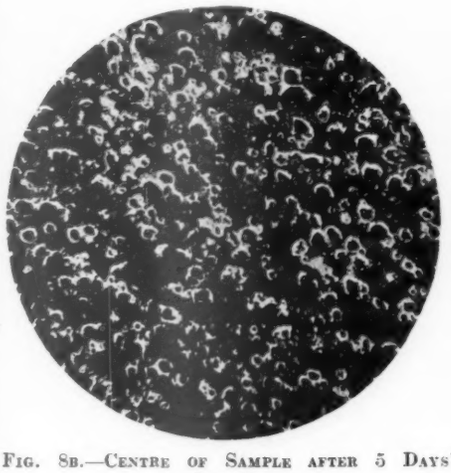

Fig. 8B.—Centre of Sample after 5 Days' Anneal.

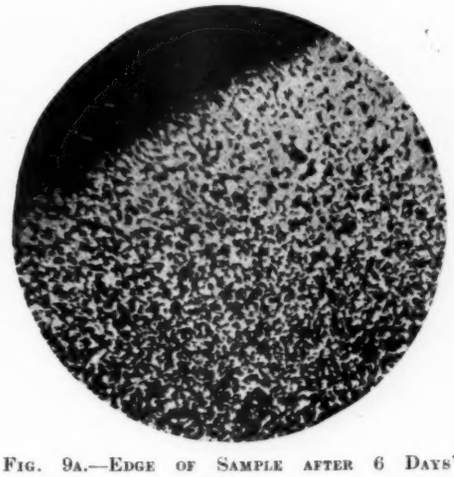

Fig. 9A.—Edge of Sample after 6 Days' Anneal.

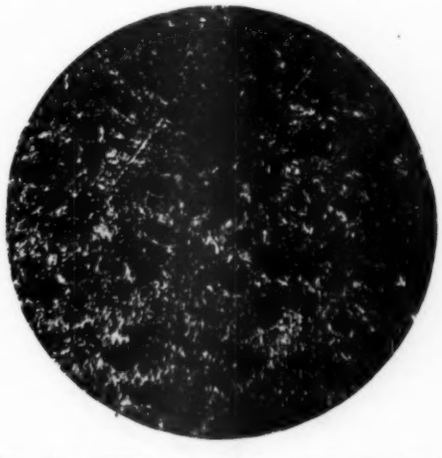

Fig. 9B.—Centre of Sample after 6 Days' Anneal. Centre wholly Pearlitic.

The Effect of Slow Cooling.

From the sixth day to the last the structure has altered greatly, although no extra fuel has been used. The furnaces were well insulated with special bricks, and the results show that the annealing continues for some time and that quick withdrawal of the fire will be injurious to the malleable properties, especially that of bending.

Brinell Tests.—It may be of interest to state that there are two types of these "black-heart" fractures, and, although macroscopically they appear the same, the microscope shows two although if it were normalised the structure would be refined and would probably pass. To normalise the first bar would make it far more brittle, remove the effects of slow cooling, and it would fail under the same test. The author suggests that for white-heart malleable cast iron the B.S.I. bars should be normalised. White-heart malleable cast iron is really steel and all steel castings are normalised. Omission in heat-treating "as-cast" steel castings would be disastrous, yet malleable castings are placed in service without this refining effect. This is very important in castings such as the motor industry

It is fundamental in the manufacture of white-heart malleable castings that the original castings should be white in fracture and have no carbon present in the graphitic state. Should graphitic-carbon be present before the anneal takes place, there is a serious loss of the physical and mechanical properties, the irons grow and when tapped with a hammer are "rotten," breaking easily and showing the dirty grey macro-structure now being discussed. This fracture belongs to the grey-iron type and is not a true malleable, but it is mentioned here because it is so often encountered in foundries where melt-

ing is carried out in a cupola furnace without scientific control.

Theories of Annealing.

In white-heart malleable cast iron the object of annealing is to remove the carbon. It is a decarbonising treatment and as such takes quite a long period. In these experiments it has been demonstrated that the first physico-chemical reaction is the deposition of graphite, according to the equation:

$$Fe_3C = 3Fe + C.$$

inert condition and revives as the carbon diffuses outward. Thus there is pressure of gases inside the can and pressure inside the castings. It is this pressure, due to heat, and supersaturation of carbon at the annealing temperature which causes the compound Fe_3C to decompose. The ring of pearlite on the outer zone has to be explained.

It is suggested that, owing to the oxidising influences existing at the outer edges, the carbon is volatilised where this is felt, and where the distance is not too great for it to diffuse. is carried on further from this point the black-heart fracture will disappear and finally become grey and dirty looking, having a crystalline inner area. Should the heat-treatment be carried on at a lower temperature a pure black-heart structure will be found.

Wüst[3] in his experiments concludes that:—(1) The process of elimination is caused by oxygen, which forms CO_2 with the annealing carbon produced during that treatment; (2) the CO_2 penetrates into the glowing iron and forms CO with the annealing carbon; (3) the CO_2 is

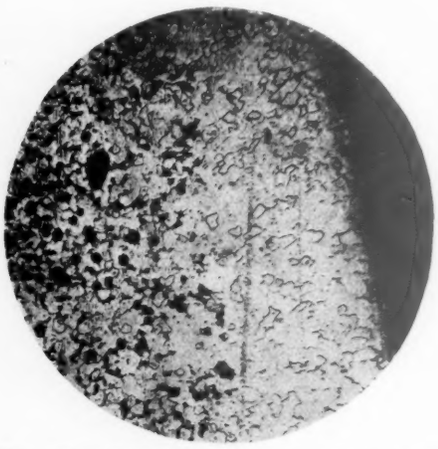

Fig. 10a.—Edge of Sample after 7 Days' Anneal.

Fig. 10b.—Centre of Sample after 7 Days' Anneal. Re-appearance of Ferrite Crystals.

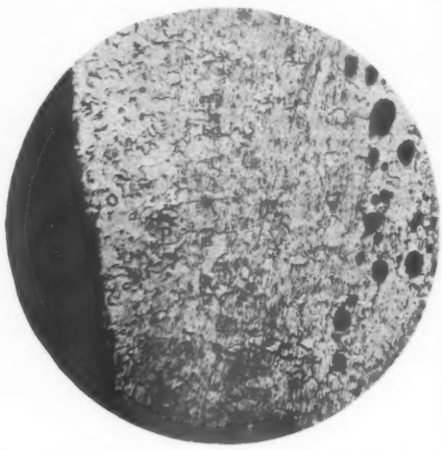

Fig. 11a.—Edge of Sample after 8 Days' Anneal.

After this has taken place the action is reversed gradually.

$$3Fe + C = Fe_3C,$$

but in this case the whole of the Fe_3C is gradually taken into solid solution. This has the property of growth as shown on the photomicrographs, and actually reabsorbs all the carbon. In the meantime the ferric oxide (Fe_2O_3) has come into chemical affinity with the carbon on the outside of the castings, according to the equation $2C + O_2 = 2CO$.

Immediately pressure is increased from the inside, causing (1) the precipitation of the free carbide and (2) the mobility of the secondary carbide which is in solution. This is the cause of the zone of pearlite. Relief is found for some of the latter at the outer zones owing to there being room for diffusion. Diffusion, owing to supersaturation, takes place directionally outwards, but as ferrite is now present inside the samples, growth of austenite also is set up towards the centre. This growth is the process

regenerated when the CO reduces the iron ore into iron protoxide and metallic iron respectively; and (4) if there is a lack of oxygen in the ore, the regeneration of CO_2 does not occur and the CO content in the gas mixture can increase to such an extent that through the decomposition of the CO the piece is decarburised.

According to this view, carbon must be precipitated before it can be removed. The ring of dense pearlite on the outer edge he ascribes to cementation due to substitution of CO for CO_2.

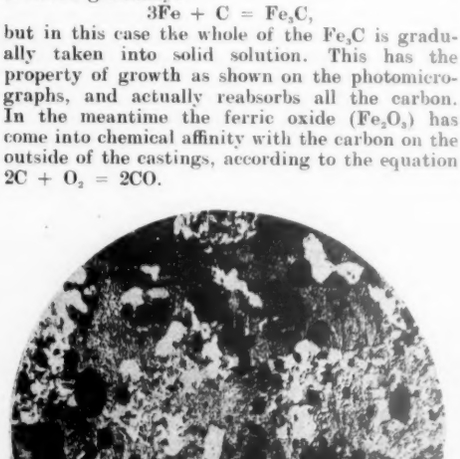

Fig. 11b.—Centre of Sample after 8 Days' Anneal. Increase of Ferrite. Lesser Pearlite.

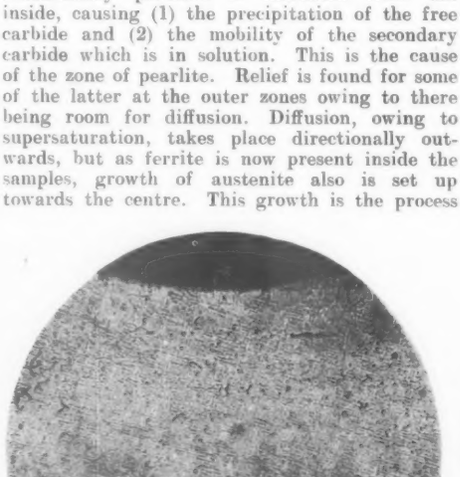

Fig. 12a.—Edge of Sample after 9 Days' Anneal.

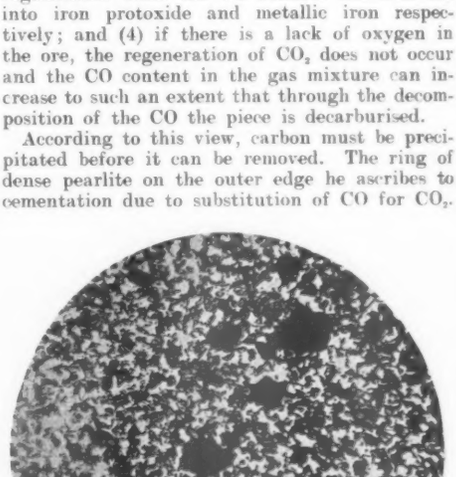

Fig. 12b.—Centre of Sample after 9 Days' Anneal.

If sufficient oxygen from the ore is decomposed it is transformed accordingly.

$$4CO + O_2 = 2CO_2 + 2CO.$$

If not the CO will oxidise as "blue candles" at the rim of the can. As Fe_2O_3 loses approximately 18 per cent. of its oxygen, according to Bergen,[2] it follows that, since the carbon is not extracted from the castings until deposition has ceased, mixed gases of CO and CO_2 are present in the annealing cans in a more or less

of cementation, but the carbon is provided by the deposited nodules. As time proceeds, this reabsorption of carbon continues until the whole mass is resaturated with carbide (in solution). The emulsive ring of carbon at the edges or outer zone is continually diffusing carbon outwards, but until ferrite makes its appearance in the inside of the castings this carbon is restored from the centre. Hence the picture frame, which is found in all white-heart malleable castings with a black-heart fracture and in many black-heart malleables. If the annealing

This CO causes an increase of carbon (in the casting). Most metallurgists would agree with (1). The author cannot accept (2), because, if CO_2 should penetrate the metal, the iron would become more or less oxidised and rotten. The penetration of CO_2 is a potential cause of peel. There is no mistaking the structure of a malleable casting which has been penetrated by CO_2. With regard to (4), the gas CO cannot decarburise a malleable casting. Owing to the

(*Concluded on page* 129.)

2 Bergen: "Stahl und Eisen," 1903. Page 1136.

3 Wüst: "Stahl und Eisen," 1903. Page 1136.

Mechanism of Deformations in Grey Iron.*

By J. W. Bolton.

Characteristic tensile and transverse stress-strain diagrams of grey-iron alloys are curved from inception—in this respect resembling those of plastic materials, that is, non-elastic materials. To a physicist such diagrams suggest that sustained application of stress may result in continued flow and ultimate failure—an assumption not in accord with the known fact that grey-iron castings subjected to considerable stresses over long periods remain sound and serviceable. This Paper shows that certain grey

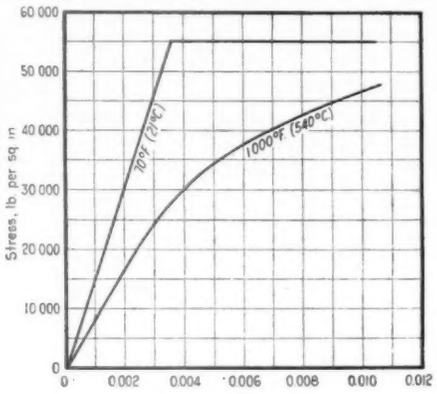

FIG. 1.—TENSION TEST STRESS-STRAIN CURVES FOR CARBON CAST STEEL.

irons subjected to relatively high static loads (at room temperatures) will hold up indefinitely. The apparent paradox—a metal whose stress-strain diagram resembles that of a plastic material, yet whose ultimate behaviour indicates a degree of true elasticity—is discussed.

It has been known for many years that

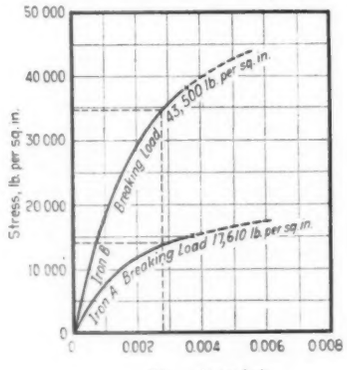

FIG. 2.—TENSION TEST STRESS-STRAIN CURVES OF TWO METALS AT ROOM TEMPERATURE.

stresses applied to grey irons cause permanent deformations or set. The amount of set, in a given iron, depends on the load—the higher the load the greater the set. When a given stress is repeated the deformation is maximum for the first loading and decreases on repeated loadings, so that after a few loadings the set increments apparently approach zero. It is known in a general way that different irons show different total sets, and that the same iron when cast into sections of various sizes shows different sets for each section on test specimens taken therefrom. The set usually increases with increase in size of section, or inversely as the tensile strength. MacKenzie† advanced the hypothesis "that a large part of the set is due to some crushing of graphite flakes or to squeezing of iron grains into the flakes or voids surrounding them," and suggests that the amount of set is proportional to the amount of graphite. Sufficient elevation of temperature with a given iron and given stress also increases set.

Structurally speaking there are certain re-

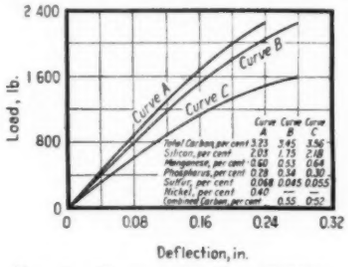

FIG. 3.—TRANSVERSE TEST STRESS-STRAIN CURVES FOR VARIOUS CAST IRONS.

semblances between carbon steel, grey cast iron and white and mottled iron. Hypoeutectoid steel as cast consists of pearlite and ferrite, the proportion of pearlite increasing with carbon content up to about 0.85 per cent. carbon, at which point the steel is all pearlitic. Grey iron usually consists of a largely pearlitic matrix (which usually has some ferrite and steadite in it, depending on the amount of combined carbon present and on the percentage of phosphorus) throughout which many graphite flakes are dispersed. These soft, easily distorted, graphite flakes may occupy 8 to 10 per cent. of the volume or space within the metal. That is, in some respects the matrix of grey iron resembles the

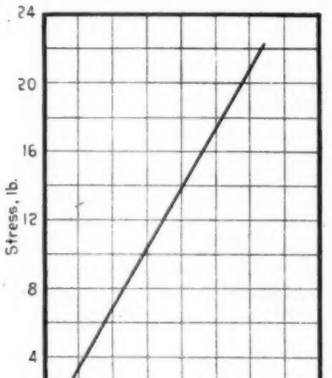

FIG. 4.—TRANSVERSE TEST STRESS-STRAIN CURVE FOR MOTTLED CAST IRON.

matrix of steels, a major difference in the alloys being the presence of 8 to 10 per cent. by volume of graphite in the grey iron. White iron consists largely of cementite plus pearlite, and mottled iron is made up of cementite, pearlite and graphite. The component, cementite, is hard and not easily distorted.

The stress-strain curve of an ordinary cast and annealed medium-carbon steel is shown in Fig. 1. As will be noted, at room temperature the stress-strain ratio is relatively constant up to a point (absolute proportionality of stress to strain over any stress range is questioned, and rightly so, by investigators employing strainometers of extreme sensitivity). However, a stress-strain curve of the same steel at 540 deg. C. (Fig. 1) exhibits a quite different appearance.

The stress-strain diagram of any grey cast iron shows curvature almost from its inception (Fig. 2 shows tensile-strength curves of two irons, one a high-test iron, iron B, the other a very low-strength iron, iron A, produced by pouring an iron adapted to light casting work into a heavy section). Fig. 3 shows some characteristic trans-

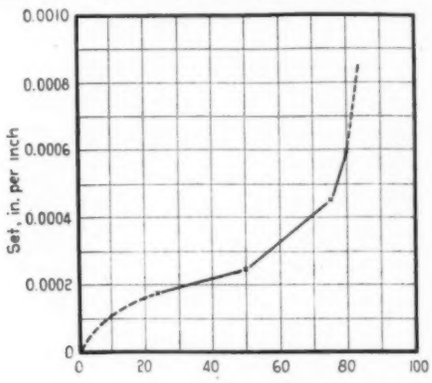

FIG. 5.—PERMANENT SET OF FOUR EXAMPLES OF AN IRON.

verse test stress-strain curves. The nature of the curves apparently suggests that grey irons are non-elastic (plastic) materials—which is rather contrary to everyday experience. The stress-strain curve of a mottled iron, shown in Fig. 4, exhibits apparent proportionality of stress to strain.

Steel within the proportional limit, as determined by room-temperature tests, exhibits elasticity. Careful tests by many investigators, including the author, indicate that well within

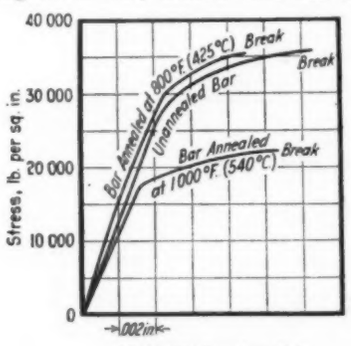

FIG. 6.—STRESS-STRAIN CURVES FOR SPECIMENS OF THE SAME IRON PREPARED BY THREE METHOD.

the proportional limit there is no appreciable permanent deformation or set on repeated stressings. The observations merely confirm the conclusions based on the regular stress-strain-diagram characteristics. It is known, too, that the nature of the stress-strain diagrams of steel tested at elevated temperatures, say 480 deg. C. and above, indicates a tendency toward plasticity. As a matter of fact, under such conditions the material is known to creep or flow continuously at stresses below the proportional limit as usually determined. That is, under the conditions cited above where the stress-strain curve is straight the material can be considered elastic, within practical interpretation. The curvature of the diagram obtained at elevated temperatures suggests a higher order of plasticity, or a lower degree of elasticity. Above the equi-cohesive temperature the proportional limit as

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* A Paper presented before the American Society for Testing Materials. The author is Chief Chemist and Metallurgist, The Lunkenheimer Company, Cincinnati, Ohio.

† J. T. MacKenzie, "Elastic Properties of Cast Iron," "Proceedings," American Society for Testing Materials, Vol. 29, Part II, page 94 (1929).

usually determined ceases to be a safe index of range elasticity.

However, Thum and Ude‡ have shown that if steels are drilled and the matrix continuity considerably broken up the character of the stress-strain diagram at room temperature is materially altered. The diagram is curved practically from inception resembling the curve typical of grey iron. Indeed Thum and Ude were attempting to simulate the probable effects of graphite flakes by artificially constructing the voids in the steel matrix.

Some experiments at the laboratories of the Lunkenheimer Company indicate that the amount of "total" permanent set may not increase in

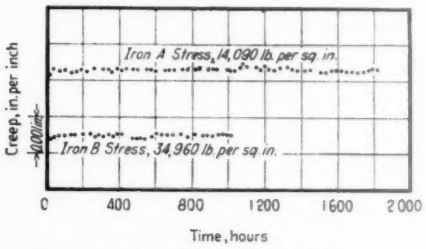

FIG. 7.—CREEP TESTS ON CAST IRON AT 40 DEG. C.

direct proportion to the loading. As shown in Fig. 5, the ratio of set to stress increased as the stress was increased. The total sets were taken on four samples of the same iron, each stressed 50 times in tension and the loads varied from 25 per cent. of ultimate strength on the first sample to 80 per cent. on the fourth. Practically all the set for each loading was obtained on the first three to five stressings. As it is obvious that there would be no set at zero loading the author has ventured to project the curve from 25 per cent. stress to zero stress.

A number of repeated-stress tension tests have been run on various irons. In no case was there any apparent marked increase or decrease in tensile strength when the test specimen was finally broken after the stress cycles had been completed. However, there was a marked tendency for the re-stressed specimen, when finally loaded to rupture, to show more of a

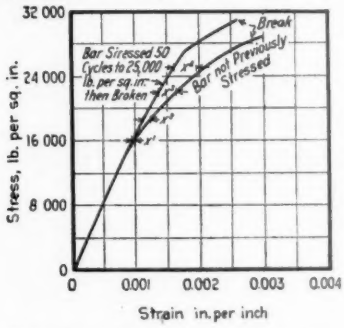

FIG. 8. — STRESS-STRAIN CURVES ILLUSTRATING THE THEORY OF THE "STRAIGHT-LINE-WITH-ELBOW" TYPE OF CURVE.

straight-line-with-elbow curve than a companion specimen which had not been subjected to cyclical stresses. Examples of this are shown in Fig. 6. In this case test specimens of the same iron were prepared as follow:—(*a*) as cast and machined, (*b*) annealed or normalised at 425 deg. C. and machined, and (*c*) annealed at 870 deg. C. and machined.

As shown in Fig. 6 all showed decided elbows on the final stress-strain curve carried to rupture of the bar. Other irons and other stresses showed the same effect, but in every case the effect was more pronounced at the higher loadings (60 to 80 per cent.). In the case of the 75 per cent. loading cyclical stresses with 50 repetitions of stress each on the irons shown in Fig. 6, the sharp elbows in the final stress-strain diagrams are just above this point, say at about 80 per cent. of the ultimate strength, suggesting a possible "elastic limit" at this point.

To test out the possibility of the actual existence of an elastic limit, creep tests were run on irons A and B referred to earlier in this Paper (iron B, tensile strength 19.4 tons per sq. in.; iron A, 7.9 tons per sq. in.). The loads chosen were 15.6 tons per sq. in. for iron B and 6.2 tons per sq. in. for iron A, these loads being about 80 per cent. of the ultimate tensile strengths of the respective samples. As shown by Fig. 7, after slight initial creep in the first 100 hours or less, no further creep was shown within the duration of the tests. (The initial readings were taken about 30 min. after loading.) The following probably is the explanation of the straight-line-with-elbow type of curve mentioned above. Below the elbow the removal of permanent set naturally straightens out the curve. Above this point, set has not been removed and the curvature represents both permanent set and elastic deformation. This is illustrated diagrammatically in Fig. 8. According to the theory just given, the distance between the two curves at any point should equal x. This is the case at the three lower loadings, and there is a slight discrepancy at the highest loading for repeated stress. However, this may be due to the two specimens not having been exactly the same strength originally. A number of samples have been examined carefully under the microscope and no evidence of incipient fractures was obtained.

The statement that the amount of permanent deformation or set is proportional to the amount of graphite is due to crushing of the graphite does not seem an adequate explanation of the set phenomena, although it probably is correct so far as it goes. Permanent deformation or set necessitates inelastic deformation of the continuous matrix, irrespective of the reaction or reactions of the non-continuous component. Let us for the moment assume that the non-continuous components (graphite flakes) consist of voids. Those familiar with the general distribution of graphite flakes in grey iron will at once perceive that since the distances between the voids are unequal, the stress distribution within the matrix will be far from uniform. This effect is illustrated diagrammatically in Fig. 9. Section A will be distorted severely and fail, even without permanent deformation in section B, if certain area ratios are maintained. The illustration, of course, is extreme. However, in grey irons the paths of fracture are along the graphite flakes and through the matrix between flakes. The following tentative explanations of stress deformation relationships in grey iron are advanced:—

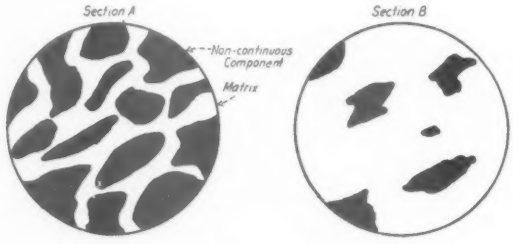

FIG. 9. — DIAGRAMMATIC REPRESENTATIONS OF CROSS-SECTIONS OF AN IMAGINARY TEST-BAR POSSESSING GREAT VARIATIONS IN STRUCTURE IN DIFFERENT PARTS OF THE BAR. THIS, OF COURSE, IS AN EXTREME OR EXAGGERATED ILLUSTRATION.

(1) The set phenomena are due to the overstressing of the portions of the matrix lying along paths of greatest stress intensity.

(2) These paths of greatest stress intensity usually lie between those graphite flakes which most closely approach each other.

(3) It is probable that overstressing various paths at a given loading results in readjustment of the matrix and the stiffening of such paths, accounting for the diminution and disappearance of further set on repeated re-stressing at constant maximum stress.

(4) When the stress is increased the increase in set probably is due to:—(*a*) Further deformation of paths overstressed at lower loads, or (*b*) deformation along new paths whose limit of elastic deformation has been exceeded.

(5) At lower deformations there probably is some compacting of graphite flakes by adjacent matrix. Beyond a certain limit of compaction the flakes cease to act as voids and offer resistance to compression. This possibly causes formation of more and more over-stressed paths with increase in load, hence in certain ranges increase in amount of set is proportionately greater than increase in loading. It also is possible that discontinuous hard particles, such as certain steadite formations, have a somewhat similar effect. In case of white and heavily mottled irons the hard component is practically continuous, so that it itself carries most of the load, resulting in the type stress-strain diagram shown previously.

(6) Obviously, with more graphite present and unfavourable size and distribution of flakes, the stress gradients within the matrix (when the sample is loaded) are greater in number and intensity. Therefore resistance to permanent deformation varies inversely with the amount of graphite if size and distribution are constant. However, the author has noted a number of cases where percentage of graphite and combined carbon were alike, yet the "sets" were different. This also is true of tensile strength. One set of bars of different sizes, yet approximately constant in graphitic and combined carbon contents, showed that tensile strength and resistance to permanent deformation were lowered as section size increased. Therefore, resistance to permanent deformation probably depends on amount, size and distribution of graphite and on the nature of the matrix rather than only on the amount of graphite present.

(7) It has been stated that the tensile strength is not increased by the cold working involved in establishment of some permanent deformation. This appears to be true within the limits of experimental accuracy involved in the methods employed. The probable answer is that approximately the same amount of cold working is done whether the specimen be repeatedly stressed to a given load and broken or broken in a regular tension test. The difference in permanent deformation, while probably favouring the re-stressed material, is so slight that the ultimate effect of this difference or increase probably is negligible.

(8) Grey irons have no true proportional limits. This is due to the extreme heterogeneity of the material and consequent stress gradients. There probably is no elastic limit (using the word in its usual sense) below the long-time ultimate strength. The long-time ultimate strength seems to be somewhat above 80 per cent. of the ultimate tensile strength as determined by short-time test. Because of its heterogeneity actual general fracture in grey iron undoubtedly is preceded by many microscopic incipient fractures. This suggests that the long-time strength probably is somewhat below the strength determined on short-time test.

Acknowledgment.—The test results referred to in this Paper were obtained, incidentally, in the course of certain other researches in the laboratories of the Lunkenheimer Company. The author is indebted to the Lunkenheimer Company for permission to publish these results.

‡ "Zeitschrift des Vereines Deutscher Ingenieure," page 251 (1930).

A Proposed Systematic Classification of Defects in the Foundry.*

In his Paper the author, Mr. C. Gierdziejewsky, justifies at length his choice of different classes of defects enumerated, and then explains why it is necessary to group them into classes according to their respective causes.

The tables given below clearly indicate without any explanation the method of classification adopted.

Table 1.—*Defects in Sizes.*

1—1.—Poor design of the casting, inevitably causing its deformation during pouring.
1—2.—Pattern or chill mould do not correspond to the design.
1—3.—Pattern or chill mould made without allowing for a shrinkage corresponding to the metal cast.
1—4.—Making the pattern without allowing for the special properties in the moulding sands used.
1—5.—Making the pattern without allowing for the influence of jointing different parts of the mould.
1—6.—Making the pattern of damp wood.
1—7.—Errors caused through bad marks on the pattern and its parts.
1—8.—Excessive rapping of the pattern in the mould.
1—9.—Bad finish of the mould.
1—10.—Bad finish of cores.
1—11.—Poor repairing of mould and cores.
1—12.—Deformation of mould and cores during drying.
1—13.—Faulty assembling. Incorrect position of various parts of the mould and cores.
1—14.—Bad arrangement of chaplets.
1—15.—Insufficient weighting of moulds.
1—16.—Excessive casting temperature.
1—17.—Swelling of the molten casting through faulty chemical composition of the metal.
1—18.—Deformation in the molten casting caused by internal fusion not eliminated through heat-treatment.
1—19.—Faulty boxes; variations.
1—20.—Boxes badly registered.
1—21.—Faulty storage of the pattern.

Table 2.—*Surface Defects.*

2—1.—Surface of pattern unsuitable.
2—2.—Permeability or cohesion of sands insufficient.
2—3.—Insufficient protection of the mould against heat.
2—4.—Bad ramming of the mould (too hard or too soft).
2—5.—Defective repairing of mould and cores.
2—6.—Defective mould grids; position of hooks.
2—7.—Lack of uniformity in moisture content in green-sand moulds.
2—8.—Insufficient drying of the mould.
2—9.—Burning of the mould during drying.
2—10.—Faulty storage of patterns.

Table 3.—*Defects Caused by Sand.*

3—1.—Insufficient cohesion of moulding sand.
3—2.—Bad ramming of the mould.
3—3.—Insufficient nailing of the mould.
3—4.—Bad position of runners.
3—5.—Errors in thickness and shape of runners.
3—6.—Bad repairing of mould and cores.
3—7.—Badly-made pouring basins.
3—8.—Defective cutting of runners in dried moulds.
3—9.—Cleaning the mould and cores for assembling.
3—10.—Insufficient cleaning of mould before assembling.
3—11.—Deterioration of the mould and cores before assembling and weighting.
3—12.—Introduction of metal in the core vents.
3—13.—Rapid exhaust, in a bad direction, of mould gases.
3—14.—Bad height of runner.
3—15.—Rod feeding without due care.
3—16.—Too long standing of the mould before pouring.

Table 4.—*Errors in Pouring: Cold Shuts.*

4—1.—Bad design of casting.
4—2.—Insufficient venting of the chill.
4—3.—Insufficient permeability of the mould.
4—4.—Too great amount of coal dust present in the moulding sand.
4—5.—Too hard ramming of the mould.
4—6.—Bad position of runners.
4—7.—Pouring basin too small.
4—8.—Absence of risers or bad position of risers.
4—9.—Errors in size and form of runners.
4—10.—Moisture content not uniform in the mould.
4—11.—Insufficient stoving of the mould and cores.
4—12.—Badly-placed chaplets.
4—13.—Fractures in the mould.
4—14.—Too low temperature in pouring the metal.
4—15.—Incorrect temperature of different parts of the chill.
4—16.—Defective gating.
4—17.—Interruptions during pouring, or pouring with a basin not wholly filled.
4—18.—Poor life of the metal.
4—19.—Insufficient amount of metal in the ladle.

Table 5.—*Blow Holes.*

5—1.—Bad construction of the casting.
5—2.—Poor-quality moulding sands (high moisture content; low permeability).
5—3.—Excessively-rammed mould.
5—4.—Insufficient permeability of the mould and cores.
5—5.—Incorrect relationship between the section of the runners and those of the vents.
5—6.—Bad position of the runners and risers.
5—7.—Insufficient stoving of mould and cores.
5—8.—Obstruction in the core-vents.
5—9.—Wrong casting-temperature.
5—10.—Casting of cold metal.
5—11.—Bad gating.
5—12.—Poor composition of the metal (excessive oxide content).
5—13.—Use of untinned chaplets.

Table 6.—*Draws.*

6—1.—Badly-designed casting.
6—2.—Exaggerated machining allowances.
6—3.—Insufficient feeding head in relation to the riser.
6—4.—Bad position of the feeding head in relation to the riser.
6—5.—Neglect of chills on those parts which cannot be dealt with by feeding heads.
6—6.—Runners of too small a section.
6—7.—Insufficient pressure of the metal in the feeding head.
6—8.—Casting temperature too low.
6—9.—Poor chemical composition of the metal.

Table 7.—*Cracks and Fissures.*

7—1.—Bad design of casting.
7—2.—Poor design of the chill mould.
7—3.—Mould or core hindering the normal shrinkage of the metal casting.
7—4.—Poor position of runners.
7—5.—Wrong sizes of denseners.
7—6.—Bad position of denseners.
7—7.—Incorrect temperature of the chill or core.
7—8.—Wrong temperature for pouring.
7—9.—Insufficient speed of pouring in the chill.
7—10.—Poor chemical composition of the metal.
7—11.—Late opening of parts of the mould.
7—12.—Too late removal of runners.
7—13.—Too rapid stripping of the casting from the chill.

Table 11.—*Ten Reasons of Wastage.*

Causes of defects.	Defects in sizes.	Surface defects.	Defects caused by sand.	Errors in pouring cold shuts.	Blow holes.	Draws.	Cracks and fissures.	Defects caused by slags.	Liquation.	Defects of the metal.
Design	1—1	—	—	4—1	5—1	6—1	7—1	8—1	—	—
Construction of pattern or chill mould	1—2 to 1—7	2—1	—	4—2	—	6—2	7—2	—	—	—
Moulding sand ..	—	2—2 and 2—3	3—1	4—3 and 4—4	5—2	—	—	8—2	—	—
Mould and cores	1—8 to 1—11	2—4 to 2—7	3—2 to 3—8	4—5 to 4—10	5—3 to 5—6	6—3 to 6—6	7—3 to 7—6	8—3 to 8—5	—	—
Stoving	1—12	2—8 and 2—9	3—9	4—11	5—7	—	—	—	—	—
Moulding ..	1—13 to 1—15	—	3—10 to 3—12	4—12 and 4—13	5—8	6—7	7—7	—	—	—
Melting	—	—	—	—	5—9	—	7—8	8—6	9—1 and 9—2	10—1 to 10—4
Casting	1—16	—	3—13 to 3—15	4—14 to 4—17	5—10 and 5—11	6—8	7—9	8—7 to 8—11	9—3 to 9—5	10—5
Metal	1—17	—	—	4—18	5—12	6—9	7—10	8—12	9—6	10—6 to 10—8
Sundry	1—18 to 1—21	2—10	3—16	4—19	5—13	—	7—11 to 7—16	8—13	9—7	10—9 to 10—13

* Extract from the Polish Exchange Paper given at the International Congress held at Milan.

7—14.—Too late removal of parts of the chill.
7—15.—Mechanical damage.
7—16.—Defective heat-treatment.

Table 8.—*Defects caused by Slags.*

8—1.—Poor design of the mould (too brusk divisional flow of the metal).
8—2.—Too-high-lime content in the moulding sand.
8—3.—Bad lay-out of runners.
8—4.—Defective size and form of runners.
8—5.—Badly-constructed pouring basin.
8—6.—Wrong melting temperature.
8—7.—Defective slagging of the metal.
8—8.—Runners badly formed at their openings.
8—9.—Too slow filling of the mould.
8—10.—Interruptions during pouring: incomplete filling of runners.
8—11.—Dirty ladles.
8—12.—Poor chemical composition of the metal.
8—13.—Poor patching of the furnace.

Table 9.—*Liquation.*

9—1.—Poor melting methods.
9—2.—Wrong method of the introduction of alloy additions in the liquid metal.
9—3.—Oxidation of the metal during casting.
9—4.—Incorrect casting temperature.
9—5.—Incorrect rate of cooling in the casting.
9—6.—Bad chemical composition of the metal.
9—7.—Excessive impurity content in the metal.

Table 10.—*Defects of the Metal.*

10—1.—Bad melting methods.
10—2.—Incorrect sequence of placing materials into the furnace.
10—3.—Incorrect order of charging the materials in the cupola.
10—4.—Incorrect melting and casting temperature.
10—5.—Faults during pouring.
10—6.—Poor chemical composition of the metal.
10—7.—Badly-killed metal.
10—8.—Too great gaseous content of the metal.
10—9.—Faults arising over control of raw materials.
10—10.—Arithmetical faults in calculating the charges.
10—11.—Choice of wrong chemical composition.
10—12.—Eccentrically held tensile test-pieces.
10—13.—Badly-machined test-pieces.

In short, Table 11 gives in synopsis the entire proposed classification explained as follow:—In the ten vertical columns are shown the various types of defects. In the horizontal columns the causes of the defects are given. As may be expected, the same defects may be the results of different causes. The author finally emphasises the great difficulty experienced in determining the cause of each defect before being able to classify them in a suitable way as shown in Table 11.

B.C.I.R.A. Elects New Members.

At the last meeting of the Council of the British Cast Iron Research Association the following firms were elected. The names of their representatives are given in brackets:—William Baird & Company, Limited, Coatbridge (Mr. James Robertson); The Kettering Iron & Coal Company, Limited, Kettering (Mr. G. H. Johnson); Modern Foundries, Limited, Halifax (Mr. Francis O'Rourke); The Stanton Ironworks Company, Limited, Stanton (Mr. P. H. Wilson); Frank Wigglesworth & Company, Limited, Shipley (Mr. F. Wigglesworth and Mr. W. Moss). The following associate members were also elected:—Mr. G. L. Harbach, Newark; Mr. Robert Lowe, Bradford; and Mr. P. L. Ward, B.Sc., Benoni, Transvaal, South Africa.

* A hundred members of the Electrical Contractors' Association paid a visit to the works of Messrs. R. A. Lister & Company, Limited, of Dursley, recently.

Foundry Selling Practice.

By Eric N. Simons.

PAYMENT OF SALESMEN.

It is impossible in one article to deal comprehensively with every actual or potential method of paying salesmen, yet the subject is one not only of importance and interest, but also of great relevance to this series of articles. The present notes should, however, be taken rather as an exploration of the ground than as a comprehensive survey of remuneration schemes, which would demand an entire book.

It is desired in this article to attack one very common principle which runs through the methods adopted by many foundries up and down the country. This is the principle that a representative should work the district allotted to him as if he were running his own little business. Those who hold this opinion argue that in serving his own interests to the maximum, *i.e.*, in earning as much as possible from the territory allotted to him, the representative is bound to benefit his employer equally effectively. The way this principle is put into practice is usually this. The representative is paid a fixed living salary, plus a small commission on orders from his territory. He is credited with the commissions that accrue to him, but whatever expenses he incurs are debited against his commission account. Thus, if the living salary is £300 per annum, and commissions total £250, expenses may total £250 also, in which case the representative will draw nothing but his salary.

Now there is a plausibility in this arrangement that makes it popular, and leads those who adopt it to assume that it works well. But examining the matter further, it is argued that because he virtually pays his own expenses, the representative has every incentive to keep those expenses down. That much may be granted. Furthermore, it is assumed that he will work as profitably and economically as possible, in order to keep his commissions high. That much, also, may be granted, with one reservation. That reservation is that what may be both profitable and economical from the point of view of the representative may not be so for the foundry. In other words, the very principle on which this scheme is built breaks down because the interests of the representative and the foundry *are not invariably identical.*

To show that this is so, and taking an imaginary case, it will be assumed that Mr. Brown has Wales allotted to him as a territory. Now the "plums," so far as Wales is concerned, are mainly in the South Wales area. There may be isolated customers in places like Wrexham or Denbigh, but they are few and far between. Now as a human being doing the best for himself, Brown will fix his residence somewhere within easy reach of the most lucrative district; probably in Cardiff or Swansea. And as a human being, he will cultivate the South Wales area intensively. The result may be that he will get his salary, plus, perhaps, a couple of hundred pounds in commission, from which he has only to deduct, say, £100 for expenses, leaving him a clear hundred to add to his fixed salary. So far, so good.

But let it be supposed that the foundry has a product, or puts on the market a product, which it thinks may interest those odd firms in Wrexham, Denbigh, and so on, or which interests isolated stone quarries or gravel pits which, by the very nature of their work, are far apart and awkward of access. It writes to Mr. Brown, and asks him to get busy.

Mr. Brown, running Wales as if he were running his own business, receives this request, and promptly weighs up the situation. He decides that to go up to Wrexham is going to cost him, perhaps, a couple of pounds, apart from the fact that it may mean a day lost in South Wales. To cover the isolated firms he is asked to cover is going to take him a week and more, and may cost him twenty or thirty pounds. The result may be good or it may not. He may get orders that will bring him in £50 of commission, or he may waste his time. It is a gamble, in which the only certainty is that he will be thirty pounds out of pocket. He can see good ways of spending his time if he stays in South Wales. Why should he depart on a possible wild-goose chase? Furthermore, it is most unlikely that one trip will make all the customers his firm expects him to make. He may have to make the same trip four times a year, which will cost him, say, £80 to £120. It is true that in two or three years he may build up a regular business that will amply repay him; but suppose things happen to him in the meantime? He may fall ill and lose his job; the firm may give up that product; he may take up another firm's representation. How can he be sure that whatever he spends now will ultimately come back to him? What it virtually amounts to is that he is to bear all the risk of pioneering, and someone else may reap the reward.

Therefore, Mr. Brown, as a wise business man running his own business, decides that the risk is too great, and pegs away at his "plums." The firm finds it cannot afford to put a special man on to work these isolated firms, and does not like to coerce Mr. Brown. So the firms who should be called upon are left alone, and a competitor with greater foresight walks away with their orders.

Pioneer Work.

Now the question the foundry has to ask itself is whether or not isolated or new firms should be called upon regularly by its representatives. If the answer is in the affirmative—and it must be remembered that the tendency nowadays is for firms to scatter themselves about the country far more extensively than was the case when the necessity of lying within easy reach of coal made it imperative to cluster together in one small area—then it must go on to ask itself whether it is reasonable to expect its representatives to bear all the cost of this pioneer work.

The average representative is conscientious and loyal. If he knew, definitely, that he would not be out of pocket for this extra effort, he would in most instances be willing to set aside a little time for pioneering work. If, furthermore, he knew in advance that he could make a little more by pioneer work even than by his regular work, he would probably be disposed to make pioneer work a regular feature of his activities. And if a firm or foundry is to live, pioneer work must be its life-blood. New customers are born every week. Old customers die with the same rapidity. New industries, new processes, spring up. If the representative does next to no pioneer work, he does not keep in touch with developments, or learns of them too late. Turnover falls off, and a firm's prosperity declines. Even the most active sales promotion and publicity departments cannot entirely replace the energetic work of the salesman on the spot. One must, therefore, study how the salesman can be persuaded to do pioneer work as keenly as he does his ordinary standard work. In the next article I hope to suggest how this may be done.

Corrosion Fatigue in Metals.—The first of a series of gatherings in connection with the forthcoming joint autumn meeting of the Iron and Steel Institute and the Institute of Metals will be held at the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.1, at 8 p.m. on September 12, when Dr. H. J. Gough, M.B.E., Superintendent, Engineering Department, National Physical Laboratory, will deliver the annual autumn lecture of the Institute of Metals on "Corrosion Fatigue in Metals." The lecturer will deal with both steel and non-ferrous metals. Visitors are invited to the lecture; cards of admission are obtainable from Mr. G. Shaw Scott, M.Sc., 36-38, Victoria Street, London, S.W.1.

The Ramp in Copper.

By "ONLOOKER."

Although fairly rapid, the improvement in copper values during the early part of August did not present any very abnormal features, but developments since the announcement that an import duty of 2d. per pound would be levied on foreign metal have assumed very much the appearance of a ramp. Standard copper was pushed up about £3 in three or four days, a rise equivalent to 10 per cent., buying being in the hands of a few prominent and powerful interests who have been very adequately supported by speculators. Consumers have bought only sparingly, but nevertheless the quotation for electro has been lifted day after day while every effort has been made to stampede buyers into purchasing by suggestions that the tax on copper may come into operation much sooner than appears likely at the moment. Business generally in the metal trades shows little signs of improvement, but unfortunately many consumers are not any too well covered and have been forced to buy at much enhanced values.

In spite of the fact that the price of copper in the United States has hardly advanced at all and is at present well below the quotation in Europe, the Wall Street boom has had a marked influence on the London metal market, and the ups and downs of the American stock market have been faithfully recorded by standard copper. At the time of writing Wall Street appears to be ripe for a setback, and should this occur standard is bound to be affected, but since the announcement that the huge reserves of copper in the States are being drawn upon, copper has strengthened materially, and looks much more promising than for some time past. Consumers are buying a certain amount, but the acute uncertainty as to when the duty will be applied is making things very difficult for them, and for the most part purchases are being made for early dates. Buyers are, of course, limited to Empire brands, for even though it is not anticipated that the tax will be put on before some time in October, no consumer is prepared to face the risk of footing a bill at the rate of nearly £20 per ton. As a result of this, values in this country have been ruling very high, well above the level on the domestic market in the States, and manufacturers have been able to buy American brands ex stocks in this country below the price asked for Empire copper.

It is an interesting commentary on the altered state of affairs in the copper situation that in the United States the advance in price has not been on the same scale as in Europe, but America behind a 4 per cent. duty is now a law unto herself, and it looks very much as if Great Britain is going to be in the same position before long. In spite of the fact that the preference granted to the Dominions carries the proviso that producers must continue to sell at world prices, the firm conviction obtains that values here are going to be higher than on the Continent, and on the standard market bidding for prompts has established a backwardation of anything from 7s. 6d. to 10s. per ton. This is not altogether surprising, for in view of the fact that the Empire copper producers entered the world curtailment pact which runs until the end of this year, it is almost certain that as far as fire-refined and Bessemer qualities are concerned, the tonnage required by this country is not available. The new Prescott refinery, which it will be remembered is to handle Rhodesian copper, does not begin to function before January 1 next, and for the moment the Empire producers are in the somewhat ignominious position of having to send their Bessemer copper to the States for refining.

It may be, of course, that our Government is fully alive to the dangers and difficulties attendant upon the application of a duty on the red metal before sufficient supplies of Empire metal are available, and if this is the case then doubtless arrangements will be made to defer the date of enforcement. Should any rumour of this sort be spread, it is safe to predict that the ramp in copper would speedily come to an abrupt conclusion.

Black-Heart Fractures in White-Heart Malleable Cast Iron.

(*Concluded from page* 124.)

amount of carbon present, CO would probably be neutral. The author is pursuing the effect of various gases upon the elimination of carbon in malleable cast iron. Hatfield[4] also objects to Wust's conclusion on the ground that carbon can be eliminated without it being precipitated in the free state, and at a temperature of 960 deg. C. much of the temper carbon would recombine with the iron.

Can carbon be removed without precipitation? The author is of opinion that carbon must be in solution before it can be removed. The free carbide must break down before removal, otherwise what would happen in a structure of austenite + free cementite? The dendrites themselves would be able to travel, and a cast structure would be seen near the outer zones. The presence of the ring of pearlite at the outer zone is an argument against this. In Hatfield's experiments the carbons were very low, viz., 1.64 per cent. His statement that the carbon would recombine with the iron is confirmed, but it never took up sufficient carbon to be supersaturated, *i.e.*, free carbide present. His other statement that the elimination of the carbon is in no way dependent upon the precipitation is incorrect. The elimination of carbon depends upon the precipitation of the carbon from the free carbide and also upon the reabsorption of the carbon commensurate with diffusion. Failing reabsorption, the carbon is not eliminated. The austenitic carbon only can be removed, when in a state of solution, and above the A arrests.

Tario Kiluta[5] states that according to the dilatometer AC1 takes place about 790 deg. C. Graphitisation begins chiefly at the boundaries of the cementite. The initial "dots" of graphite coagulate while further cemetite is decomposed. Temper carbon surrounded by ferrite appears scattered all over the pearlite ground. As the composition was that of a black-heart malleable *i.e.*, Si 1.1 per cent. and T.C. 2.20 per cent., it is hardly a fair comparison with the author's experiments but it appears to confirm his results.

Professors Kotario Honda and Murakami[6], as the results of experiments arrived at the conclusion that graphitisation is caused by the catalytic action of CO or CO_2 and is not a direct decomposition of cemetite at high temperature according to the equation

$$Fe_3C = 3Fe + C.$$

The nature of the catalytic action is not very clear but the following hypothesis is assumed. "When molten metal dissolving CO solidifies at 1,130 deg. a certain quantity of free gas separates but remains intermingled with its mass." At this high temperature there still exists a partial pressure for CO_2, and a minute quantity of this gas will be produced thus:

$$2CO = CO_2 + C.$$

This CO_2 reacts on cementite according to the equation: $CO_2 + Fe_3C = 2CO + 3Fe$.

The result is that Fe_3C is gradually decomposed, giving rise to graphite and iron, because the CO_2 newly formed is transformed into CO again. Thus, if there is only a small quantity of free CO in the metal initially, the above reactions proceed step by step and the cementite is continually graphitised.

The following experiments were carried out upon the metal mentioned herein. One set of test-bars were annealed in ferro-silicon. This was given a full six days' anneal, as mentioned in these Papers. The bars were examined, and the micro-examination revealed an unbroken centre. There were many nodules of graphite present, but the centre was in the "as-cast" state. Had this argument been correct, then the structure should have broken down; in fact, it should have entirely graphitised, because the action he speaks of had commenced and should have proceeded.

Another was annealed in an atmosphere of hydrogen. In this case the precipitation occurred at a much lower temperature, *i.e.*, about 800 deg. C., and the outer zone of pearlite was present, as in the series mentioned in this work. In neither case was CO_2 present, unless a trace was present in the metal itself, but if the action is due to a little CO_2, the latter bars should not have been broken at all. The first would not yield to the drill after a full six days' anneal. The hydrogen-annealed bar was drilled quite easily after one day.

Summary.

(1) Black-heart fractures in white-heart malleable cast iron is due to insufficient annealing and is caused by the presence of nodular carbon.

(2) White-heart malleable annealing is carried out in three operations:—

(*a*) Decomposition of free carbide.

(*b*) Oxidation of carbon held in solution.

(*c*) Reabsorption of deposited carbon and its diffusion to replace the eliminated carbon.

(3) The picture frame is due to the mobility and decomposition of the carbide in solution causing (*a*) a zone of supersaturated austenite; (*b*) pressure from the inside due to the graphitising of the austenitic and free carbides.

(4) Very little carbon is eliminated until the carbide has broken down, the physical reactions in this case tending to ease up the chemical reaction of the ferric oxide.

(5) The reabsorption of carbon increases the tensile strength and decreases the elongation and bend values.

(6) No explanation of the loss and increase of sulphur is offered. Further investigation is necessary in this respect.

The author sincerely thanks the following for their kindly help and criticisms of the above work:—The Staffordshire Education Committee; Mr. T. G. Bamford, M.Sc., Principal, County Technical College, Wednesbury; Mr. Lester, of the above college, for assistance with mechanical tests, and the Directors of Murray Foundries, Limited, Walsall.

4 Hatfield: "Journal Iron and Steel Institute." 1909. Vol. 1.
5 Tario Kaluta: "Iron and Steel Research Institute." Fifty-Seventh Report.
6 Honda and Murakami: "Science Reports," Tôhoku Imp. University. Vol. X. Page 273. 1921.

London Foundry Classes.

The Sir John Cass Technical Institute, Jewry Street, Aldgate, London, E.C.3, is becoming more and more recognised as the principal centre for learning foundry work. The evening classes have been arranged to cover the requirements of the City and Guilds Institute and the Institute of British Foundrymen's Craft Certificate. Principal Patchin takes a live personal interest in this section of his work, and is enthusiastically supported by Mr. Gibbs, a past-chairman of the London Section of the Institute of British Foundrymen, and Dr. Jones. Students are to be enrolled from September 14 to September 16, between the hours of 5.30 and 8.30 p.m.

Skyscrapers in the Wind.—Mr. D. Coyle, consulting engineer of New York, in the course of a Paper read at the recent International Congress of Bridge and Structural Engineering, estimated that a tower-like building 244 m. (say 800 ft.) high, with a base 30 m. (say about 100 ft.) wide, and weighing about 730 tons, will make about 15 vibrations in a minute when exposed to a wind force of 117 kg. per sq. m. (say 24 lbs. per sq. ft.).

Raw Material Markets.

Orders are badly needed at the iron and steel works, and now that the holiday season is practically at an end producers are looking for indications of an expansion of trade. Conditions are believed to favour an improvement. The commodity markets are again stronger, and if the international situation is not yet much clearer, at least there is hope of an expansion of Empire trade as a result of the Ottawa Conference. These hopes, however, are mainly for the future, and it is immediate orders of which the makers stand in urgent need. There is certainly more inquiry about. So far it has not been translated into many fresh orders, but that consumers are obviously testing the market is a favourable sign. Stocks held by consumers, both at home and abroad, are known to be low, and with any improvement in general conditions business in iron and steel should soon come along. Export business still remains very difficult, although rather more interest is being taken in some directions.

Pig-Iron.

MIDDLESBROUGH.—The Cleveland ironmasters adhere to their fixed prices, namely, for No. 1 Cleveland foundry iron, 61s. per ton; No. 3 Cleveland G.M.B., 58s. 6d.; No. 4 foundry, 57s. 6d.; and No. 4 forge, 57s. per ton, f.o.t. or f.o.b. Local consumers of Cleveland iron seem to be looking for some reduction, but the makers give no hint of any revision of the figures, which have remained constant for a long period now. There is some resentment among consumers at the preference given to Scottish users, who are able to buy, delivered in Scotland, at some 3s. or so below the fixed f.o.t. works price to local users. There is no expansion in the demand for pig-iron so far. Most of the foundries are still short of work, so that their pig-iron requirements are restricted, and with the price position as it is there is little inducement for them to enter into forward commitments. There is more inquiry about, however, which may presage some expansion of business in the month just begun.

There is greater animation in the East Coast hematite market, although prices remain at a low level. Inquiries are in larger volume, and there is some slight expansion of the export trade. Only small lots are being sold in current trade, and makers are hoping for an increase in the size of individual orders. Preparations are again afoot for the restarting of two furnaces at the Ayresome Ironworks. East Coast mixed numbers are quoted at 60s. per ton and No. 1 at 60s. 6d. There is no change in conditions in the North-West Coast hematite trade. Makers are content at the moment to await events, and, in the meantime, prices are unchanged.

LANCASHIRE.—The slight improvement in the volume of business placed by Lancashire consumers has not been maintained, and the position is now further complicated by the dispute in the cotton industry, which cannot fail to have a depressing effect on the iron and steel industry in the area. Deliveries into consumption this week are certainly on a smaller scale. The scrap position is also a factor in depressing the Lancashire pig-iron market. There are large supplies of scrap available at low prices. Pig-iron quotations are maintained, as follow:—Derbyshire, Staffordshire and North-East Coast No. 3, 67s. per ton; Northamptonshire foundry iron, 65s. 6d.; Derbyshire forge iron, 62s.; Scottish foundry iron, 84s. 6d.; West Coast hematite, 81s. Indian iron is available at from 67s. to 77s. per ton, according to grade, including delivery to users in the Manchester area.

MIDLANDS.—The makers of light castings in the Midland area are beginning to feel the effect of the seasonal expansion of trade, and the outlook for pig-iron is correspondingly better. Unfortunately other branches of the foundry industry are no better situated, and there seems to be little prospect of any sustained improvement in the near future. Prices, meanwhile, are unchanged. Northants No. 3 is at 62s. 6d., and Derbyshire, North Staffs and Lincolnshire No. 3 are at 66s., delivered Birmingham and Black Country stations, with forge pig-iron at 5s. below the respective No. 3 level. Cleveland No. 3 is available at the Derbyshire price, but only odd lots are coming into this district. Continental foundry pig-iron remains uncompetitive in the Midlands. There is no improvement in the hematite market. The price of West Coast No. 3 or mixed numbers is 84s. 6d. delivered works. Welsh and East Coast foundry numbers are at prices between 76s. and 82s. 6d. per ton, according to quantity and analysis.

SCOTLAND.—There is nothing of interest to report regarding the pig-iron trade in Scotland, which remains dull and depressed. The consuming trades are poorly engaged. Some improvement may be expected with the end of the holiday season, but there would seem to be little ground for pronounced optimism regarding the future. There is no alteration in the official minimum of 69s. 6d. for Scottish No. 3 foundry iron, at furnaces. No. 3 Middlesbrough is at 55s. 6d. at Falkirk, with other English irons at about 1s. to 1s. 6d. less. Scottish hematite is at 68s. 6d., delivered.

Coke.

There have been no developments in the foundry coke market, which generally is quiet. Under present conditions consumers have limited needs, either of foundry or furnace coke. Any pronounced increase in the demand would probably bring higher prices. Consumers in Birmingham and district can buy best Durham furnace coke at 37s. 6d., and cheaper grades at 35s., delivered. Prices of Welsh foundry coke range from 30s. to 45s. delivered, according to quality.

Steel.

Quiet conditions continue to rule in the steel market. Most of the finished-steel works have difficulty in keeping plant in operation, owing to the great scarcity of orders. Few of the consuming trades have large needs at present. The shipbuilding industry, particularly, is very poorly engaged, and the consequent lack of orders for shipbuilding steel is a serious matter to the steelworks. There are few orders about for semi-finished steel. A substantial amount of business is still going abroad, owing to the low prices quoted by Continental makers.

Scrap.

In view of the lack of work at the foundries in the Cleveland area, sellers of scrap have difficulty in realising 35s. for ordinary heavy cast iron or 36s. for good machinery quality. Light castings are at about 30s. Heavy cast iron in large pieces and furnace sizes has a moderate demand in South Wales and prices remain steady at 42s. 6d. Good cast-iron machinery scrap for foundry purposes is very quiet, but there are one or two inquiries for material, for which sellers are asking 45s. to 47s. 6d. In the Midlands the scrap market is still very quiet. Good supplies of all qualities are available, but the demand is poor. Cast-iron scrap shows no improvement. Most of the local foundries are slack and are not keen buyers. Heavy machinery metal in handy sizes is offered at 45s. delivered, good heavy metal at 40s., and clean, light cast iron at 35s. delivered. Flat conditions continue in Scotland. The foundries are still quiet, and machinery cast-iron scrap, first quality, in pieces not exceeding 1 cwt., only realises about 44s. For ordinary heavy cast-iron scrap to the same specification, 38s. to 39s. is quoted. Light metal is at 33s. to 35s., delivered consumers' works.

Metals.

Copper.—The copper market has maintained a firm tone, the prospective duty of 2d. per lb. on Empire metal having imparted additional strength. The date of the imposition of the duty can at the moment only be a matter of speculation: in view of the fact that Parliament does not meet until towards the end of October, nothing can very well be decided before November. The duty—over £18 per ton—should be effective in keeping foreign copper out of the United Kingdom. There is a stipulation that sales of Empire metal must be made at the world price, but there is nevertheless some uneasiness among consumers as to the effect of the duty on prices. They are not sure that, even with the price proviso, Continental buyers will not in the result be able to secure their copper at a better figure than the trade here. In any case, it is pointed out that if adequate supplies are to be available the Empire producers will have to increase their output to considerably above the current production level. The market for the production of the big South American mines will be further restricted, and it is probable that the world price will register a decline as the result of the duty. However, this is in the future. At the moment consumptive demand is better, although it is unlikely that actual consumption has increased. Refined metal is being purchased rather more freely, both here and on the other side of the Atlantic. Steady conditions are expected for some little time. Any considerable fall in values would not seem to be warranted; on the other hand, there does not appear to be any reason why prices should move to much higher levels, at any rate, in the near future.

Closing quotations:—

Cash.—Thursday, £34 to £34 2s. 6d.; Friday, £34 3s. 9d. to £34 6s. 3d.; Monday, £34 16s. 3d. to

(*Concluded on page* 132.)

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In suitable qualities for the manufacture of:
HIGH CLASS ENGINEERING CASTINGS, MOTOR CYLINDERS, LIGHT CASTINGS, RAINWATER GOODS, BATHS, RANGES, GRATES, STOVES, HOLLOW WARE and all FOUNDRY PURPOSES.

We also make Forge Iron for Wrought Iron Makers and Basic Iron for Steel Works use.

RANGE OF ANALYSIS

	Lloyds & Islip.	S.V.H.
Silicon	2% to 5%	1% to 3%
Sulphur	·01% to ·04%	·04%
Phosphorus	1·6%	·5% to ·8%
Manganese	·35%	·5% to ·1%

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HANNAH STREET, DOCKS.

This Week's News in Brief.

Trade Talk.

The tug "Foremost 34," constructed by Messrs. Scott & Sons, Bowling, has completed trials on the Clyde.

Messrs. Cochrane & Sons, Limited, shipbuilders, Selby, have received an order at their Ouse shipbuilding yard for a steel screw trawler.

Messrs. James A. Silver, Limited, Roseneath, have secured orders for three motor cruisers for early spring delivery from well-known Clyde owners.

The directors of the London Tin Corporation, Limited, propose to cancel the 550,650 unissued 10s. preference shares and create ordinary shares in their place.

Considerable damage was done to machinery in a fire recently in the rod-mill engine house of the Stocksbridge steelworks of Messrs. Samuel Fox & Company, Limited.

The "Corabank," a vessel of 9,000 tons, built at Belfast by Messrs. Workman Clark (1928), Limited, for Messrs. Andrew Weir, Limited, Glasgow, has completed successful trials on the Clyde.

Damage of considerable extent was done by a fire which broke out at the works of Messrs. T. W. Lench, Limited, nut and bolt manufacturers, Blackheath, Birmingham, recently. The fire originated in an oil tank.

The British Aluminium Company, Limited, Adelaide House, King William Street, London, E.C.4, announce that the telephone number of their new London warehouse at 23-25, Pancras Road, N.W.1, is North 5301 (two lines).

In the large electric shovel of the Ransome & Rapier type 4120, which was demonstrated recently at the makers' Waterside Works, Ipswich, and supplied to the order of the Bundi Portland Cement, Limited, for their quarry in India, the principal steel castings, such as the top and bottom frames, the bucket teeth, etc., were supplied by Edgar Allen & Company, Limited.

Messrs. J. W. Jackman & Company, Limited, Vulcan Works, Blackfriars Road, Manchester, announce that, consequent upon the death of their managing director, Mr. John Sugden, they are closing their London office. Mr. W. H. Littleton, who for many years has been attached to the London office, is to remain in the area. His address is 8, Worbeck Road, Anerley, London, S.E.20, and his telephone number Sydenham 3002.

After being closed for a fortnight for electrical alterations necessary for the change-over to the national grid system, the Skinningrove Steel and Iron Works, Saltburn, were reopened recently. Four furnaces, damped down when the works closed, have been put into full blast again. The Loftus ironstone mine, owned by Messrs. Pease & Partners, Limited, which supplies the works with ore, also was reopened, after being idle for two weeks.

The L.N.E. Railway Company have placed a contract with Messrs. Sir William Arrol & Company, Limited, for the extension and improvement of the pier at Southferry, part of a scheme to permit of the regular running of the ferry service on a fixed time-table independent of the tide. This firm has also secured an order to erect a new mechanically-operated bridge over the canal in the main street of Kirkintilloch to replace the present wooden structure.

Messrs. Beyer, Peacock & Company, Limited, locomotive engineers, Manchester, have acquired by purchase the business and assets of Richard Garrett & Sons, Limited, Leiston, Suffolk. The business will be continued as heretofore, and spare parts for Garrett products will be available. In addition to the products formerly manufactured by Richard Garrett & Sons, Limited, it is intended from time to time to supplement these with others for which there may be a demand.

Edgar Allen & Company, Limited, have just put on the market a new machine for filling bags with cement, lime, etc. This is known as the Stag Silextractor, and it has been developed to provide a simple and inexpensive apparatus for extracting such materials as cement and other powdered or granular substances from silos or other containers in which these materials are stored, and filling bags with them. Full particulars of this machine can be obtained on application.

The world's largest steel wire rope, approximately 7½ miles long, in one continuous length without joints or splices, weighing approximately 57 tons and measuring 4⅝ in. in circumference, made by the Whitecross Company, Limited, Warrington, was produced by the aid of Edgar Allen K.9 oil-hardening steel. The dies were made from this steel, and only one set was used throughout the whole job, whereas it is often necessary to use several sets of dies where heavy rope is being manufactured.

Messrs. Head, Wrightson & Company, Limited, of Stockton and Thornaby, have secured a contract from the Stanton Iron Works Company, Limited, acting on behalf of the Wellingborough Iron Company, Limited, for the supply and erection of two complete blast-furnace plants at Wellingborough. The demolition of the present plant will commence this month, and the erection of the new works will be proceeded with at once. The work, which will provide considerable employment at the Teesdale works, will take several months to complete.

The 9,000-tons deadweight steamer "Harborough," the third vessel to be completed in recent weeks by Lithgows, Limited, Port Glasgow, for Messrs. J. & C. Harrison, London, carried out successful trials on the Clyde. This cargo steamer is a sister ship to the "Harmatris" and "Harmenteh," constructed by the same firm and fitted with propelling machinery by Messrs. David Rowan & Company, Limited, Glasgow. Three more vessels of the same type are on the stocks at Messrs. Lithgow's, and will be launched at intervals before the end of the year.

The Import Duties Advisory Committee have given notice of applications for increased import duties on the following products of interest to the foundry industry:—(*a*) Hand-driven grass and lawn mowers; (*b*) bolts, nuts and screws of iron or steel or non-ferrous metals (other than screws for wood); (*c*) iron and steel rivets; (*d*) boot studs and hobnails of all kinds of metal; (*e*) shoe nails and rivets of iron, steel or brass; and (*f*) firearms, air guns, air rifles and air pistols and parts thereof. Any representations which interested parties desire to make in regard to these applications should be addressed in writing to the Secretary, Import Duties Advisory Committee, Caxton House (West Block), Tothill Street, London, S.W.1, not later than September 14.

Personal.

Mr. James Anderson, of Grangemouth, has been appointed to succeed Mr. James Pearson, local secretary of the Transport and General Workers' Union in Grangemouth, when Mr. Pearson retires at the end of the present year.

Mr. John G. Stephen, a director of the firm of Messrs. Alexander Stephen & Sons, Limited, Linthouse, Glasgow, has been appointed to a vacancy on the board of directors of the National Bank of Scotland, Limited. Mr. Stephen became a director of the firm in 1924 and is general manager of the shipyard.

Alderman Walter S. Hill, late of Redcar, who left £26,532, gave £2,250 to the Cleveland Technical Institute for a scholarship to be called the "Alfred Clayton Hill Scholarship," in promoting technical and scientific education and for the advancement of young men training for positions of blast-furnace engineers or managers.

Mr. J. A. Franklin, International President of the American Boilermakers' Society, arrived in Glasgow during the week to study the shipbuilding and engineering conditions. He made a special visit to the yard of Messrs. John Brown & Company, Clydebank, to inspect the unfinished Cunarder. During his stay in the district he will confer with local trade union leaders and representatives of the principal Clyde establishments. Mr. Franklin will also represent the American Federation of Labour at the British Trade Union Congress at Newcastle on September 5.

Mr. S. P. Hewitt has been appointed general manager of Edgar Allen & Company (Canada), Limited, 116, McGill Street, Montreal. Mr. Hewitt, whose father, Mr. S. J. Hewitt, is chief metallurgist of Edgar Allen & Company, Limited, Sheffield, will be responsible for the conduct of the entire Canadian business, including sales. Mr. J. K. Schofield will remain secretary and treasurer to the company, while Mr. G. E. Membery will continue to be in charge of the Toronto branch of Edgar Allen & Company (Canada), Limited, and will act as sales manager.

Obituary.

We regret to announce the death of Mr. L. T. L. McCully, who was drowned whilst bathing at Tenby on August 23. Mr. McCully was a representative of John Varley, Limited, Waterloo Foundry, St. Helens, Lancashire.

The death occurred on August 26, in a Glasgow nursing home, of Mr. Hugh Martin, J.P., late of the Dundyvan Iron Works, Coatbridge. Mr. Martin, who was in his 59th year, was a magistrate of Coatbridge, a director of Coatbridge Gas Company, and manager of the Alexander Hospital, Coatbridge.

The death occurred at his residence in Kilmacolm, Renfrewshire, on August 22, of Mr. William Arthur Coulson, a director of the firm of Mavor & Coulson, Limited, Bridgeton, Glasgow, and of Messrs. Creed & Company, Limited, Croyden. Mr. Coulson, who had been associated with Messrs. Mavor & Coulson for over 40 years, was a partner in the original firm before it was converted into a limited liability concern. He was highly esteemed by all the employees, as was demonstrated last year when at the celebration of the jubilee of the firm he received a presentation from staff and workpeople. Mr. Coulson was for many years associated with Messrs. Creed & Company, Limited, Croyden, and at the time of his death retained his seat on the board. Although during the last few years Mr. Coulson had been practically in retirement, the family connection with Mavor & Coulson has been maintained by his son, who holds an important position in the works.

Raw Material Markets.

(*Concluded from page* 130.)

£34 17s. 6d.; Tuesday, £35 15s. to £35 16s. 3d.; Wednesday, £35 15s. to £35 17s. 6d.

Three Months.—Thursday, £33 12s. 6d. to £33 15s.; Friday, £33 17s. 6d. to £34; Monday, £34 11s. 3d. to £34 12s. 6d.; Tuesday, £35 10s. to £35 12s. 6d.; Wednesday, £35 11s. 3d. to £35 12s. 6d.

Tin.—Prices on this market have also been upheld, and there is talk of even higher levels in the near future. An improvement in the inquiry for tin in the United States is recorded. In this country consumptive demand shows only small improvement, but good support is being given to the market and speculative interest has been active. Any considerable increase in the demand would probably soon result in higher levels, although there is always the existence of large reserves in the background. The statistical position is too obscure to give any indication of future developments. Some time must elapse before the effects of the exports and production "holiday" are discernible.

Official closing prices:—

Cash.—Thursday, £145 15s. to £146; Friday, £147 15s. to £148; Monday, £149 15s. to £149 17s. 6d.; Tuesday, £149 15s. to £150; Wednesday, £148 to £148 2s. 6d.

Three Months. — Thursday, £147 5s. to £147 7s. 6d.; Friday, £148 15s. to £149; Monday, £151 to £151 2s. 6d.; Tuesday, £150 15s. to £151; Wednesday, £149 to £149 5s.

Spelter.—There cannot be much hope for this metal in this country while the galvanisers and other consumers are working at such a low level of production, but at the current level of prices the market is firm. Further small advances in prices are likely, as the tone of the market is good. World stocks are reported to be declining.

Daily fluctuations:—

Ordinary.—Thursday, £14 2s. 6d.; Friday, £14 2s. 6d.; Monday, £14 7s. 6d.; Tuesday, £14 10s.; Wednesday, £15 1s. 3d.

Lead.—Lead prices have appreciated in sympathy with other metals. There is still considerable room for improvement in the demand for lead, but some advance does seem to have been made recently, and the market maintains a firm tone. The market in the United States also appears to have strengthened. There does not seem to be much room for a setback in this metal.

The week's prices have been:—

Soft foreign (prompt).—Thursday, £11 17s. 6d.; Friday, £12; Monday, £12 7s. 6d.; Tuesday, £13 2s. 6d.; Wednesday, £13 8s. 9d.

The United States Steel Corporation has authorised the expenditure of $5,000,000 on replacements and improvements.

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MOULDING BOXES

Stand up to the exacting Requirements of the Modern Foundry

because

They are made from Rolled Steel

In the course of a day's work each box part must be handled several times. For quantity production, therefore, light moulding boxes are essential.

To withstand the brunt of rapid handling and the heavy pressures of the modern moulding machine, the box must be strong, rigid and unbreakable.

For the production of castings true to pattern free from fins and crossed joints, accurate moulding boxes are not only necessary but vital.

In no other type of moulding box will you find such uniform accuracy of pins and parting faces, nor just that correct ratio of the necessary factors to ensure long life without undue weight.

LET US HAVE YOUR ENQUIRY FOR YOUR NEXT LOT OF BOXES.

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FOUNDRY SPECIALTIES LTD.,

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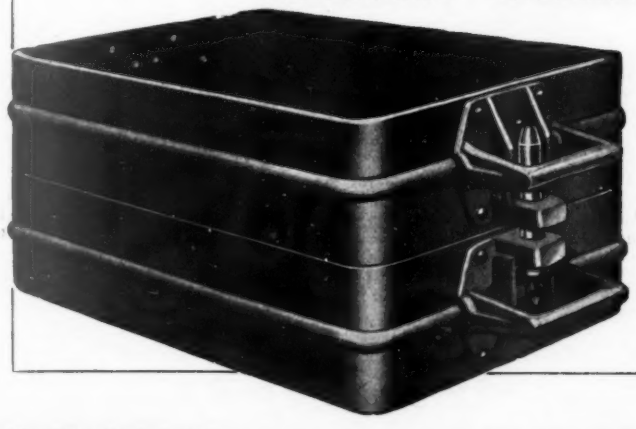

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YOU CAN RELY ON THE NAME

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	35	15	0
Three months	35	11	3
Electrolytic	37	10	0
Tough	36	0	0
Best selected	36	10	0
Sheets	65	0	0
India	46	0	0
Wire bars	37	10	0
Do., Oct.	37	10	0
Do., Nov.	37	10	0
Ingot bars	37	5	0
H.C. wire rods	40	0	0
Off. av. cash, July	26	2	5 9/14
Do., 3 mths., July	25	13	6 9/7
Do., Sttlmnt., July	26	1	10 9/7
Do., Electro, July	29	10	0
Do., B.S., July	28	15	10
Do., wire bars, July	29	17	10 3/7
Solid drawn tubes			10d.
Brazed tubes			10d.
Wire			6½d.

BRASS.

Solid drawn tubes	9d.
Brazed tubes	11d.
Rods, drawn	8d.
Rods, extd. or rlld.	5d.
Sheets to 10 w.g.	7⅝d.
Wire	7½d.
Rolled metal	7½d.
Yellow metal rods	4½d.
Do. 4 × 4 Squares	5½d.
Do. 4 × 3 Sheets	5½d.

TIN.

	£	s.	d.
Standard cash	148	0	0
Three months	149	0	0
English	149	15	0
Bars	152	0	0
Straits	153	0	0
Australian	151	10	0
Eastern	155	5	0
Banca	155	0	0
Off. av. cash, July	125	19	5½
Do., 3 mths., July	127	12	3½
Do., Sttlmt., July	125	19	0½

SPELTER.

	£	s.	d.
Ordinary	15	1	3
Remelted	14	2	6
Hard	12	7	6
Electro 99.9	17	7	6
English	16	0	0
India	14	5	0
Zinc dust	21	0	0
Zinc ashes	2	0	0
Off. aver., July	11	15	6 3/7
Aver. spot, July	11	11	10 1/7

LEAD.

	£	s.	d.
Soft foreign ppt.	13	8	9
Empire	13	12	6
English	15	5	0
Off. average, July	9	19	8 3/7
Average spot, July	9	16	4 3/7

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	22	10	0
Do., V.M. ex-whse.	22	0	0
Rods	26	0	0
Boiler plates		—	
Battery plates		—	

ANTIMONY.

	£	s.	d.		£	s.	d.
English	35	0	0	to 42	10	0	
Chinese				24	10	0	
Crude				16	0	0	

QUICKSILVER.

	£	s.	d.
Quicksilver	9	5	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	£8 5 0
45/50%	£13 10 0
75%	£19 10 0
Ferro-vanadium—	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% c. free of Mo.	6/3 per lb.
Ferro-titanium—	
23/25% carbon-free	11½d. lb.
Ferro-phosphorus, 20/25%	£22 0 0
Ferro-tungsten—	
80/85%	1/9 lb.
Tungsten metal powder—	
98/99%	2/- lb.
Ferro-chrome—	
2/4% car.	£34 0 0
4/6% car.	£25 5 0
6/8% car.	£24 10 0
8/10% car.	£22 7 6
Ferro-chrome—	
Max. 2% car.	£37 0 0
Max. 1% car.	£46 15 0
Max. 0.70% car.	£45 17 6
70% carbon-free	1/1 lb.
Nickel—80/99.5%	£240 to £245
"F" nickel shot	£216 0 0
Ferro-cobalt	7/9 lb.
Aluminium 98/99%	£95 0 0
Metallic chromium—	
96/98%	2/9 lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export (nom.)	£9 15 0
Metallic manganese—	
94/96% carbon-free	1/4½ lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 3/16 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

	£	s.	d.		£	s.	d.
South Wales—							
Heavy steel					1	19	0
Bundled steel and shrngs.	1	15	0	to 1	19	0	
Mixed iron and steel	1	15	0	to 1	16	0	
Heavy cast iron					2	2	6
Good machinery	2	5	0	to 2	7	6	
Cleveland—							
Heavy steel					1	15	0
Steel turnings					1	8	0
Cast-iron borings					1	2	6
Heavy forge					2	10	0
W.I. piling scrap					2	2	6
Cast-iron scrap	1	15	0	to 1	16	0	
Midlands—							
Light cast-iron scrap					1	15	0
Heavy wrought iron					2	2	6
Steel turnings, f.o.r.					0	19	0
Scotland—							
Heavy steel					1	15	0
Ordinary cast iron					1	18	6
Engineers' turnings					1	7	6
Cast-iron borings					1	10	0
Wrought-iron piling					2	0	0
Heavy machinery					2	4	0

London—Merchants' buying prices delivered yard.

	£	s.	d.
Copper (clean)	26	0	0
Brass	16	0	0
Lead (less usual draft)	10	10	0
Tea lead	9	0	0
Zinc	8	0	0
New aluminium cuttings	74	0	0
Braziery copper	23	0	0
Gunmetal	18	0	0
Hollow pewter	65	0	0
Shaped black pewter	65	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	61/-
Foundry No. 3	58/6
Foundry No. 4	57/6
Forge No. 4	57/-
Hematite No. 1	60/6
Hematite M/Nos.	60/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	71/-
,, d/d Birm.	84/6
Malleable iron d/d Birm.	117/6
Midlands—	
Staffs No. 4 forge*	61/-
,, No. 3 fdry.*	66/-
Shrops basic	—
,, Cold blast, ord.	—
,, ,, roll iron	—
Northants forge*	57/6
,, fdry. No. 3*	62/6
,, fdry. No. 1*	65/6
Derbyshire forge*	61/-
,, fdry. No. 3*	66/-
,, fdry. No. 1*	69/-
,, basic*	—

*d/d Black Country dist.

Scotland—	
Foundry No. 1	72/-
,, No. 3	69/6
Hem. M/Nos. d/d	68/6
Sheffield (d/d district)—	
Derby forge	58/6
,, fdry. No. 3	63/6
Lincs forge	—
,, fdry. No. 3	63/6
E.C. hematite	74/-
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby forge	62/-
,, fdry. No. 3	67/-
Staffs fdry. No. 3	67/-
Northants fdry. No. 3	65/6
Cleveland fdry. No. 3	67/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	84/6
Clyde, No. 3	84/6
Monkland, No. 3	84/6
Summerlee, No. 3	84/6
Eglinton, No. 3	84/6
Gartsherrie, No. 3	84/6
Shotts, No. 3	84/6

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.		£	s.	d.
Bars (or.)	9	5	0	to 9	15	0	
Nut and bolt iron	7	15	0	to 8	10	0	
Hoops	10	10	0	to 12	0	0	
Marked bars (Staffs) f.o.t.				12	0	0	
Gas strip	10	10	0	to 12	0	0	
Bolts and nuts, ¾ in. × 4 in.				12	0	0	
Steel—							
Plates, ship, etc.	8	15	0	to 8	17	6	
Boiler plts.	8	7	6	to 9	5	0	
Chequer plts.				10	7	6	
Angles				8	7	6	
Tees				9	7	6	
Joists				8	15	0	
Rounds and squares, 3 in. to 5½ in.				9	7	6	
Rounds under 3 in. to ¾ in. (Untested)				6 12 6 & up.			
Flats—8 in. wide and over				8	12	6	
,, under 8 in. and over 5 in.				8	17	6	
Rails, heavy	8	5	0	to 8	10	0	
Fishplates				12	0	0	
Hoops (Staffs)				9	10	0	
Black sheets, 24g.	8	0	0	to 8	10	0	
Galv. cor. shts.	9	0	0	to 9	5	0	
Galv. flat shts.	9	10	0	to 10	5	0	
Galv. fencing wire, 8g. plain				12	10	0	
Billets, soft	4	17	6	to 5	7	6	
Billets, hard				6	12	6	
Sheet bars	4	15	0	to 5	5	0	
Tin bars				4	15	0	

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	10½d.
Sheet to 10 w.g.	11½d.
Wire	11½d.
Rods	10½d.
Tubes	10d.
Castings	12½d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated

	Dols.
No. 2 foundry, Phila.	13.84
No. 2 foundry, Valley	14.50
No. 2 foundry, Birm.	11.00
Basic	15.39
Bessemer	16.89
Malleable	16.39
Grey forge	16.39
Ferro-mang. 80% seaboard	68.00
O.-h. rails, h'y, at mill	43.00
Billets	26.00
Sheet bars	26.00
Wire rods	37.00
	Cents.
Iron bars, Phila.	2.11
Steel bars	1.60
Tank plates	1.60
Beams, etc.	1.60
Skelp, grooved steel	1.60
Steel hoops	1.45
Sheets, black, No. 24	2.20
Sheets, galv., No. 24	2.85
Wire nails	1.95
Plain wire	2.20
Barbed wire, galv.	2.60
Tinplates, 100-lb. box	$4.75

COKE (at ovens).

Welsh foundry	20/- to 22/6
,, furnace	16/- to 16/6
Durham and Northumberland—	
,, foundry	21/- to 25/-
,, furnace	12/-
Midlands, foundry	—
,, furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box	15/- to 15/3
,,	28×20 ,,	30/- to 30/6
,,	20×10 ,,	22/- to 22/3
,,	18¾×14 ,,	15/6 to 15/9
C.W.	20×14 ,,	12/9 to 13/3
,,	28×20 ,,	—
,,	20×10 ,,	—
,,	18¾×14 ,,	—

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6 0 0 to £7 0 0
Bars-hammered, basis	£16 10 0 to £17 0 0
Bars and nail-rods, rolled, basis	£15 17 6 to £16 5 0
Blooms	£10 0 0 to £12 0 0
Keg steel	£32 0 0 to £33 0 0
Faggot steel	£18 0 0 to £23 0 0
Bars and rods dead soft, st'l	£10 0 0 to £12 0 0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.	
Aug.	25 ..	34	0	0	dec. 5/-
,,	26 ..	34	3	9	inc. 3/9
,,	29 ..	34	16	3	,, 12/6
,,	30 ..	35	15	0	,, 18/9
,,	31 ..	35	15	0	No change

Electrolytic Copper.

		£	s.	d.	
Aug.	25 ..	36	10	0	No change
,,	26 ..	36	15	0	inc. 5/-
,,	29 ..	36	15	0	No change
,,	30 ..	37	0	0	inc. 5/-
,,	31 ..	37	10	0	,, 10/-

Standard Tin (cash).

		£	s.	d.	
Aug.	25 ..	145	15	0	inc. 60/-
,,	26 ..	147	15	0	,, 40/-
,,	29 ..	149	15	0	,, 40/-
,,	30 ..	149	15	0	No change
,,	31 ..	148	0	0	dec. 35/-

Tin (English ingots).

		£	s.	d.	
Aug.	25 ..	147	10	0	inc. 60/-
,,	26 ..	149	10	0	,, 40/-
,,	29 ..	151	10	0	,, 40/-
,,	30 ..	151	10	0	No change
,,	31 ..	149	15	0	dec. 35/-

Spelter (ordinary).

		£	s.	d.	
Aug.	25 ..	14	2	6	No change
,,	26 ..	14	2	6	,, ,,
,,	29 ..	14	7	6	inc. 5/-
,,	30 ..	14	10	0	,, 2/6
,,	31 ..	15	1	3	,, 11/3

Spelter (Electro, 99.9 per cent.).

		£	s.	d.	
Aug.	25 ..	16	10	0	No change
,,	26 ..	16	10	0	,, ,,
,,	29 ..	16	15	0	inc. 5/-
,,	30 ..	16	17	6	,, 2/6
,,	31 ..	17	7	6	,, 10/-

Zinc Sheets (English).

		£	s.	d.	
Aug.	25 ..	22	10	0	No change
,,	26 ..	22	10	0	,, ,,
,,	29 ..	22	10	0	,, ,,
,,	30 ..	22	10	0	,, ,,
,,	31 ..	22	10	0	,, ,,

Lead (English).

		£	s.	d.	
Aug.	25 ..	13	15	0	No change
,,	26 ..	13	15	0	,, ,,
,,	29 ..	14	5	0	inc. 10/-
,,	30 ..	15	0	0	,, 15/-
,,	31 ..	15	5	0	,, 5/-

AVERAGE MONTHLY PRICES OF STEEL RAILS.

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1917	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6
1918	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6	10 17 6
1919	10 17 6	13 7 6	13 7 6	13 7 6	15 0 0	15 10 0	16 0 0	16 10 0	16 10 0	16 10 0	16 10 0	17 5 0	14 12 11
1920	18 15 0	19 5 0	20 7 6	22 0 0	23 0 0	23 0 0	24 0 0	25 0 0	25 0 0	25 0 0	25 0 0	25 0 0	22 18 11½
1921	23 5 0	20 4 0	18 0 0	17 0 0	15 0 0	15 0 0	14 0 0	14 0 0	14 0 0	11 12 6	10 10 0	10 0 0	15 4 3
1922	9 10 0	9 10 0	9 10 0	9 10 0	9 10 0	9 10 0	9 10 0	9 0 0	8 15 0	8 15 0	8 15 0	8 15 0	9 4 2
1923	8 17 6	9 2 0	10 5 0	10 10 0	10 10 0	10 10 0	9 15 0	9 0 0	8 15 0	8 15 0	8 19 0	9 5 0	9 9 10
1924	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 2 6	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 2 3½
1925	9 0 0	9 0 0	9 0 0	9 0 0	8 15 0	8 10 7½	8 10 0	8 10 0	8 10 0	8 4 0	8 0 0	8 0 0	8 11 7½
1926	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 7 6	8 10 0	8 10 0	8 10 0	8 10 0	8 3 11½
1927	8 10 0	8 10 0	8 10 0	8 2 6	8 2 6	8 2 6	8 2 6	8 2 6	8 2 6	8 3 0	8 5 0	8 5 0	8 4 10
1928	8 5 0	8 5 0	8 5 0	8 5 9	8 6 3	8 6 3	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 7 9½
1929	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0
1930	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0
1931	8 9 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 8
1932	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	8 7 6	—	—	—	—	—

AVERAGE MONTHLY PRICES OF EAST COAST HEMATITE AT MIDDLESBROUGH.

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1916	133 9	140 0	136 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	128 1½
1917	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6
1918	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6	122 6
1919	122 6	122 6	122 6	122 6	179 2	190 0	197 6	200 0	200 0	200 0	200 0	200 0	171 4
1920	220 0	220 0	240 0	260 0	260 0	260 0	260 0	260 0	260 0	260 0	260 0	260 0	251 8
1921	240 0	220 0	180 0	180 0	180 0	160 0	160 0	160 0	137 0	127 6	117 6	104 6	162 2
1922	97 6	91 7½	100 0	98 6	97 1½	94 7	93 6	90 9	89 7	91 10½	93 0	93 2	94 5½
1923	94 6	104 9	122 0	126 10½	122 0	115 3	107 0	98 8½	98 10½	99 1½	100 6½	102 3	107 10½
1924	102 4½	101 3	99 7½	99 0	98 9½	97 4½	95 3½	93 1½	90 7½	88 0	88 4½	88 6	95 2½
1925	87 5	85 9	84 7½	82 6	80 10½	79 3	77 1½	75 7½	75 0	74 3½	74 9	76 0	79 5½
1926	77 3	77 9	77 3½	76 3	77 4½	78 0	79 8½	81 9	83 4½	87 7½	92 6	90 5½	81 7½
1927	90 0	90 0	86 3½	83 1½	80 6	78 0	76 6	75 4½	75 0	72 9	71 9	71 1½	79 2½
1928	69 7½	69 7½	69 9	70 0	70 0	69 3	68 7½	69 2	70 0	70 0	70 3	71 0	69 9½
1929	71 6	72 0	73 6	74 0	74 0	74 1½	74 9	75 6	76 1½	76 8½	78 1½	79 0	74 11½
1930	78 2½	78 0	76 9	75 0	74 0	72 7½	71 0	71 0	71 0	71 0	70 10½	70 4½	73 3½
1931	70 0	69 0	68 0	66 8½	65 1½	63 4½	62 9	61 1½	65 0	65 0	65 0	65 0	65 0
1932	64 10	64 3	63 6	63 6	63 6	62 7½	62 0	60 6	—	—	—	—	—

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.

13, RUMFORD STREET, LIVERPOOL.

PIG

IRON

All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,

CENTRAL CHAMBERS, 93, HOPE ST., GLASGOW, C.2.

ZETLAND ROAD, MIDDLESBROUGH.

SMALL ADVERTISEMENTS.

Notice.

Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 6 words per line. Minimum charge for one insertion 3/-

(A remittance should accompany instructions.)

SITUATIONS WANTED.

FOUNDRY FOREMAN desires position; practical and technical training all branches; grey iron, semi-steel, malleable, die-casting, and all non-ferrous metals. Take entire charge foundry and patternshop.—Box 242, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY MANAGER desires engagement. Had exceptional experience in the practical, technical and metallurgical control of all types of chilled, grain and alloy rolls, cupola and air-furnace, and in general, electrical and rolling-mill castings, ingot moulds and blocks to 100 tons.—Box 254, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

PATTERNMAKER requires post; general and motor experience, also rubber manufacturers' work; mechanical drawing certificate. —Box 256, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

STOREKEEPER, Garage Manager or Transport Manager (Motor), disengaged; 22 years' stores experience, 5 years' garage and transport, with world-known firms; accurate, adaptable, energetic; undeniable references; go anywhere, do anything.—Box O.G.R., Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

EMPLOYMENT REGISTER.

Conducted by the Institute of British Foundrymen by courtesy of the proprietors of THE FOUNDRY TRADE JOURNAL.

Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, from whom full particulars can be obtained of this service.

Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

EXPERIENCED and well-known Foundry Manager is open to consider new engagement. Has had complete control of large foundries engaged in all branches of ironfoundry work, from small repetition work to castings of 50 tons. (189)

POSITION required by young man just completed Full-time Course in Foundry Practice. Has had several years' experience as Analytical Chemist. Has extensive knowledge of Iron, Steel Works and Foundry Practice. Position desired as Metallurgist or executive position with prospects. (190)

POSITION required as Foundry Metallurgist or foundry executive position. Sound practical experience moulding, core-making, cupola and pattern shop. Good technical and commercial training. (191)

POSITION required as Foreman or Assistant Foreman, by young Moulder with good experience in general Engineering Foundries, including Iron, Steel, Malleable and Non-ferrous. City and Guilds Diploma. (192)

AGENCY.

LONDON export merchant house with 50 years' connection Continental consumers would undertake exclusive export sale of Specialities for Foundries and Steel Works, etc. Have also extensive connection London export houses.—Reply to Box 252, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

PROPERTY.

MAGNIFICENT

11 ACRES WORKS SITE.

SHEFFIELD.

145,000 Sq. Ft. of Shops.

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with L.M. & S. and L. & N.E. Rlys.

WELL-BUILT & COMMODIOUS OFFICES

Will Sell whole or in lots to suit customers or Let on favourable terms. Unique opportunity for Manufacturers.

Apply—

THOS. W. WARD, LTD.,

ALBION WORKS, SHEFFIELD.

FOUNDRY for Sale, with two modern 6-ton Cupolas, Steel Staging, Electric Hoist; Sidings alongside.—Further details, Box 246, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

MACHINERY.

THOMAS C. WILD, LIMITED,
Electrical and Mechanical Engineers,
FREEDOM WORKS, JOHN STREET, SHEFFIELD.

SECONDHAND BLOWERS, IN FIRST-CLASS CONDITION.

ONE 12-in. KEITH BLACKMAN CUPOLA BLOWER, Motor 220/250 volts D.C., 40 h.p., 1,630/2,800 r.p.m. Complete with new Brookhirst Controller Panel.

Two 12-in. BLOWERS similar to above by APPLEBY, Motor 31 h.p., 1,450 r.p.m., 440 volts, 3-phase, 50 periods.

One 12-in. BELT-DRIVEN STURTEVANT BLOWER. Motor and Controller for A.C. or D.C. can be supplied from stock.

One NEW 9 in. ROOTS BLOWER by THWAITES, Belt-driven.

All Electrical Equipment sold by us carries our usual 12 months' guarantee.

S. C. BILSBY, A.M.I.C.E., A.M.I.E.E.

Carries a large stock of **FOUNDRY PLANT** which, generally, includes :—

Power and Hand Moulding Machines, Sand Mills and Disintegrators, Sand Blast Plants, Ladles, Melting Furnaces, Grinding Machines, Blowers and Exhaust Fans, Air Compressors, etc., etc.

Also 300 A.C. and D.C. Electric Motors, ¼ to 200 h.p., and Generators, to suit most systems.

All at low prices. Please send your inquiries to :—

215, BARCLAY ROAD, WARLEY,
Nr. Birmingham.

'Phone : Bearwood 1103.

WORKS ADDRESS : Crosswells Road (next G.W.R. level crossing), Langley, near Birmingham. 'Phone : Broadwell 1359.

THOS. W. WARD, LTD.

20-kw. Petrol Dr. Generating Set, 4 cyl., 110 v., 750 revs.

Pneumatic Sand Moulding Machine, cap. 16" x 16" x 6".

Geared Foundry Ladle, 29" dia. at top, 27" deep, $\frac{5}{16}$" plate.

BABCOCK W.T. BOILER, 180 lbs. w.p.

WIRE ROPES, $\frac{1}{32}$" dia., 360' long.

ALBION WORKS, SHEFFIELD.

'Grams : Forward. 'Phone, 23001 (10 lines).

" Albion " Catalogue on application.

MISCELLANEOUS.

OUR DEXTRIN CORE GUM, reliable strength, has a reputation all over England as well as abroad. Please post us your inquiry, stating quantity, for carriage-paid terms.—WILLIAM OLSEN, LIMITED, The Foundry Suppliers, Hull.

MISCELLANEOUS—*Continued*

STRAW ROPES, own make, always at lowest carriage-paid terms. We invite orders and/or inquiries. Also Wood Fibre Core Ropes, all sizes.—WM. OLSEN, LIMITED, Cogan Street, Hull.

PATENT.

PATENTS AND DESIGNS ACTS, 1907 TO 1928.

NOTICE IS HEREBY GIVEN that Comstock & Wescott Inc., of 80, Federal Street, City of Boston, State of Massachusetts, United States of America, seek leave to amend the Specification of Letters Patent No. 306,107 granted to them for an invention entitled " Improvements in Processes of Treating Iron Ores."

Particulars of the proposed amendment were set forth in No. 2275 of the Official Journal (Patents), published on August 24, 1932.

Any person or persons may give Notice of Opposition to the amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton Buildings, London, W.C.2, within one calendar month from the date of publication of the said Journal.

W. S. JARRATT,
Comptroller-General.

SALE BY TENDER.

Re WIGSTON FOUNDRY COMPANY, LIMITED, SOUTH WIGSTON, near LEICESTER.

By Order of S. FRED ASPELL, ESQ., F.C.A., the Receiver and Manager,

MESSRS. FULLER, HORSEY, SONS & CASSELL are instructed to offer for SALE by TENDER, in ONE LOT as a GOING CONCERN, on MONDAY, SEPTEMBER 12, the

BUSINESS, GOODWILL AND STOCK-IN-TRADE

of the above Company, which has been established upwards of 40 years and has a high reputation for the quality of its products.

The Work in Progress, Patterns, Drawings, and the Running Contracts are included in the Sale, so that a Purchaser can transfer the Business to his own Foundry. Should he desire to continue it *in situ*, the Freehold Foundry and Engineering Works can be acquired, and ANY OFFER for same with or without the Plant and Machinery would be considered.

Tenders should be enclosed in a sealed envelope marked " Tender *re* Wigston Foundry," and delivered to the Receiver and Manager, S. FRED ASPELL, ESQ., F.C.A., Eagle House, Friar Lane, Leicester, by 4 p.m. on the date above-mentioned.

Further Particulars may be had of MESSRS. ASPELL, DUNN & COMPANY, Chartered Accountants, Eagle House, Friar Lane, Leicester, or of MESSRS. FULLER, HORSEY, SONS & CASSELL, Engineers' Valuers and Factory Agents, 11, Billiter Square, Fenchurch Street, E.C.3.

'Phone : 287 SLOUGH

LADLES—GEARED

12-Ton	"Stevenson"	£48
9-Ton	"MacNeil"	£42
4-Ton	"Evans"	£28
3-Ton	"Evans"	£24
2-Ton	"Evans"	£19

PNEUMATIC MACHINES

18"×18" Tabor split pattern	£45
30"×40" Tabor rollover ...	£160
No. 2 Britannia Jolters	... 2 @ £36
No. 0 Britannia Jolters	... 4 @ £20
Core Jolters, 3" Cylinder new,	£4 each

ABOVE ARE AS NEW.

BUY FROM ME AND SAVE MONEY!

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